DL850/DL850V
ScopeCorder
USER'S MANUAL

Features Guide

YOKOGAWA
Yokogawa Meters & Instruments Corporation

IM DL850-01EN
2nd Edition

Thank you for purchasing the DL850 ScopeCorder or DL850V ScopeCorder Vehicle Edition (hereinafter, “DL850/DL850V” will refer to both of these products). This manual contains useful information about the features of the DL850/DL850V. To ensure correct use, please read this manual thoroughly before beginning operation.
Keep this manual in a safe place for quick reference in the event a question arises. The following four manuals, including this one, are provided as manuals for the DL850/DL850V. Read them along with this manual.

Manual Title	Manual No.	Description
DL850/DL850V ScopeCorder Features Guide	IM DL850-01EN	This manual. The supplied CD contains the PDF file of this manual. This manual explains all the DL850/DL850V features other than the communication interface features.
DL850/DL850V ScopeCorder User’s Manual	IM DL850-02EN	The supplied CD contains the PDF file of this manual. The manual explains how to operate the DL850/DL850V.
DL850/DL850V ScopeCorder Getting Started Guide	IM DL850-03EN	The manual explains the handling precautions and basic operations of the DL850/DL850V and provides an overview of its features.
DL850/DL850V ScopeCorder Communication Interface User’s Manual	IM DL850-17EN	The supplied CD contains the PDF file of this manual.The manual explains the DL850/DL850V communication interface features and instructions on how to use them.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument’s performance and functions. The figures given in this manual may differ from the actual screen.
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1 Main Features

Vertical Axis

This section explains how to configure the signal input settings and the amplitude-direction display settings. The items that can be set vary depending on the installed modules. The channel menu that corresponds to the key you pressed (CH1 to CH16) appears. You can set the various vertical axis settings for each channel. Press ALL CH to display a screen in which you can configure the settings of all channels while viewing the settings in a list.

DL850/DL850V Measurement Items

When the DL850/DL850V is equipped with the modules listed below, it can measure voltage, temperature, strain, acceleration, frequency, logic, CAN bus signals, and so on.

Voltage

701250 (HS10M12), 701251 (HS1M16), 701255 (NONISO_10M12), 701260 (HV (with RMS)), 720210 (HS100M12), 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), 701265 (TEMP/HPV), 701275 (ACCL/VOLT)

Voltage (For the 16-CH Voltage Input Module)

720220 (16CH VOLT)

Temperature

701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), 701265 (TEMP/HPV)

Strain

701270 (STRAIN_NDIS), 701271 (STRAIN_DSUB)

Acceleration

701275 (ACCL/VOLT)

Frequency

701280 (FREQ)

Logic

720230 (LOGIC)

CAN Bus Signal Monitoring

720240(CAN MONITOR)
This module can only be used with the DL850V.

Vertical Scale

The vertical scale is used to adjust the displayed waveform amplitude so that you can easily view signals. You can set the vertical scale to determine the value per grid square (1 div) displayed on the screen and to set the measurement range.
Use the SCALE knob to set the vertical scale for each channel.

Vertical Position

Because the DL850/DL850V can display many waveforms, the waveforms may overlap and be difficult to view. If this happens, you can adjust the vertical display position to make waveforms easier to view (vertical position).
Use the POSITION knob to set the vertical position for each channel.

Input Coupling

You can change the input coupling setting to match the signal that you are measuring. By changing the setting, you can choose how the vertical-axis (voltage-axis) control circuit is coupled to the input signal. The following types of input coupling are available: DC, AC, GND, TC, DC-RMS, AC-RMS, ACCEL, and OFF.* Set the appropriate input coupling for each input module.

* You can only select OFF for sub channels on the 16-CH Voltage Input Module. Sub channels set to OFF are not measured.

Vertical Zoom

You can zoom the waveform vertically. You can zoom the waveform by setting the vertical magnification or by setting upper and lower display limits.

Linear Scaling

Linear scaling is a function that converts measured values into physical values and reads them directly. There two types of linear scaling:

AX+B

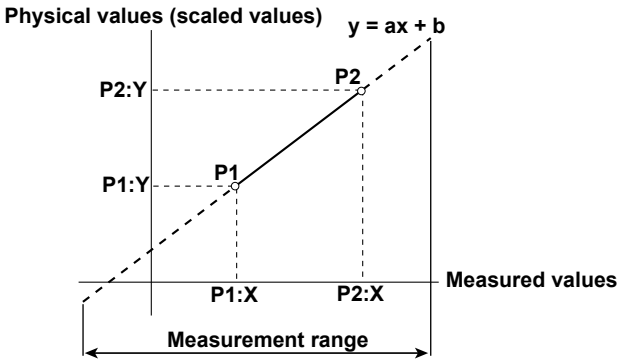
Using scaling coefficient A and offset B, the DL850/DL850V scales values according to the equation below.

Y= AX + B (where X is the measured value and Y is the physical value)

P1-P2

The DL850/DL850V determines the scale conversion equation (y = ax + b) using four values that you specify: two measured values (P1:X, P2:X) and the value that each one should be converted to (P1:Y, P2:Y).

The DL850/DL850V scales values using the scale conversion equation that it determines.



Horizontal Axis (Time Axis)

Time Axis Setting

Normally, under the initial settings, the time axis scale is set as a length of time per grid division (1 div). The selectable range is 100 ns/div to 3 days/div.* As you adjust the value, the unit changes between seconds, minutes, hours, and days automatically. Because the horizontal display range is 10 div, the amount of time on the waveform that is displayed is equal to the time axis setting × 10.

* When the 720210 (HS100M12) module is installed, the scale range starts at 100 ns/div; when it is not installed, the scale range starts at 1 µs/div.

Internal and External Clocks (Time base selection)

Under the initial settings, the DL850/DL850V samples the measured signal using the internal clock signal produced by its internal time-base circuit.

You can also use an external clock signal to control sampling. Apply the external clock signal to the external-clock input terminal. This external clock input is useful for synchronizing to the clock signal of the waveform that is being measured.

Relationship between the Time Axis Setting, Record Length, and Sample Rate

If you change the time axis setting, the sample rate and the acquisition-memory record length also change. For details, see appendix 1 in the *Getting Started Guide*, IM DL850-03EN.

Sample Rate

If you change the time axis setting, the sample rate also changes. The sample rate is the number of samples-per-second (S/s). When the sample rate is low compared to the frequency of the input signal, the high-frequency components of the waveform are misread as low-frequency components. To prevent the high-frequency components from being misread, sample the signal at the highest sample rate possible, or set the waveform acquisition mode to Envelope.

Roll Mode Display

When the trigger mode is set to Auto, Auto Level, Single, or On Start and the time axis setting is greater than or equal to 100 ms/div, instead of updating waveforms through triggering (update mode), the DL850/DL850V displays the waveforms in roll mode. In roll mode, waveforms scroll from right to left as new data is captured and the oldest values are deleted from the screen.

Trigger

A trigger is a cue used to display the waveform on the screen. A trigger occurs when the specified trigger condition is met, and a waveform is displayed on the screen.

Trigger Modes

The trigger mode determines the conditions for updating the displayed waveforms. There are six trigger modes: Auto, Auto Level, Normal, Single, N Single, and On Start. The trigger mode setting applies to all trigger types.

Trigger Types

Triggers can be broadly divided into “simple triggers” and “enhanced triggers.”

Simple Triggers

Input Signal Trigger

The DL850/DL850V triggers when the trigger source passes through the specified trigger level in the specified way (rising edge, falling edge, or rising or falling edge).

Time Trigger

The DL850/DL850V triggers at the specified date and time and at specified intervals afterwards.

External Signal Trigger

The DL850/DL850V triggers when the signal applied to the TRIG IN terminal passes through the specified trigger level in the specified way (rising or falling edge).

Power Line Signal Trigger

The DL850/DL850V triggers on the rising edge of the power supply signal that it is receiving. This trigger enables you to observe waveforms in synchronization with the power supply frequency.

Enhanced Triggers

A -> B(N) Trigger

After state condition A is met, the DL850/DL850V triggers when state condition B is met N times.

A Delay B Trigger

After state condition A is met and the specified amount of time elapses, the DL850/DL850V triggers when state condition B is first met.

Edge On A Trigger (Enhanced)

While state condition A is met, the DL850/DL850V triggers on the OR of multiple trigger source edges.

OR Trigger

The DL850/DL850V triggers on the OR of multiple trigger source edges.

AND Trigger

The DL850/DL850V triggers on the AND of multiple trigger source conditions. The DL850/DL850V triggers when all the specified conditions are met at a single point.

Period Trigger

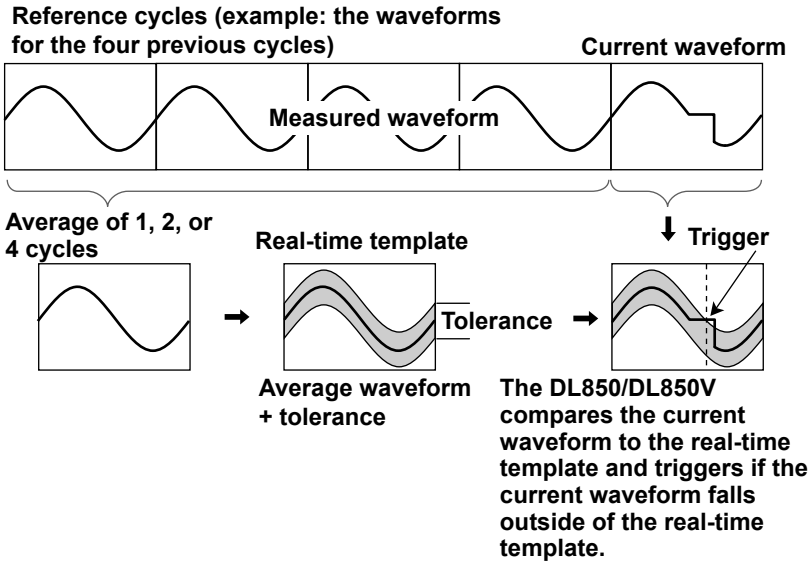
The DL850/DL850V triggers on a specified period of occurrence of state condition B. The DL850/DL850V triggers when state condition B occurs again.

Pulse Width Trigger

The DL850/DL850V triggers according to the relationship between the state condition B achievement time and the specified reference times (Time or T1 and T2).

Wave Window Trigger

The DL850/DL850V creates real-time templates (Wave Window) using a number of cycles directly preceding the current waveforms. The DL850/DL850V compares the current waveforms to the real-time templates and triggers if one of the current waveforms falls outside of its real-time template.


Reference cycles (example: the waveforms for the four previous cycles)
Current waveform
Measured waveform
Average of 1, 2, or 4 cycles
Real-time template
Trigger
Tolerance
Average waveform + tolerance
The DL850/DL850V compares the current waveform to the real-time template and triggers if the current waveform falls outside of the real-time template.

Trigger Source

Trigger source refers to the signal that is used to check the specified trigger conditions. You can set the trigger source to an analog signal, logic signal, time, external signal, or power line signal. Select the appropriate trigger source for the trigger type.

Trigger Level

Trigger level refers to the signal level used as a reference for detecting a signal's rising and falling edges or high and low states. With simple triggers such as the edge trigger, the DL850/DL850V triggers when the trigger source level passes through the specified trigger level. The range and resolutions that you can use to set the trigger level vary depending on the type of signal being measured.

Waveform Acquisition

Based on the data that has been stored in the acquisition memory, the DL850/DL850V performs various operations, such as displaying waveforms on the screen, computing, measuring cursors, and automatically measuring waveform parameters.

You can set the number of data points to store in the acquisition memory (the record length), enable or disable the sample data averaging feature, and so on.

Record Length

Record length refers to the number of data points that are stored to the acquisition memory for each channel. *Display record length* refers to the data points from the data stored in the acquisition memory that are displayed on the screen. Normally, the acquisition-memory record length and display record length are the same, but the time axis setting may cause them to differ. When you change the time axis setting, the sample rate and record length also change.

On the standard model of the DL850/DL850V, you can set the record length to a value between 1 kpoint and 250 Mpoint. Depending on the model, you can set the record length to a value of up to 2 Gpoint.

Acquisition Mode

Specify how the DL850/DL850V processes the sampled data, stores it in the acquisition memory, and uses it to display waveforms. There are four acquisition modes: Normal, Envelope, Averaging, and BoxAverage.

Hard Disk Recording

When measurement starts, you can record data to an external hard disk that supports eSATA (external Serial ATA; /HD0 option) or to an internal hard disk (/HD1 option).* The recorded data is saved to files automatically. You can load the saved data using the DL850/DL850V and convert it to a format that you can analyze on a PC (ASCII or floating point).

* Models with the /HD0 option are equipped with eSATA connectors. You need to purchase a hard disk that supports eSATA separately.

History

When waveforms are being measured, the waveform data stored in the acquisition memory as a result of a trigger occurrence is displayed as a waveform on the DL850/DL850V screen and can be viewed. When waveform acquisition is being triggered in succession and an abnormal waveform appears, it is impossible to stop acquisition before a new waveform appears on the screen. Normally, it would be impossible to view the abnormal waveform. However, with the history feature, you can view the past waveform data (history waveforms) stored in the acquisition memory when waveform acquisition is stopped. You can select specific history waveforms and display them.

You can also search through the history waveforms for waveforms that meet specified conditions.

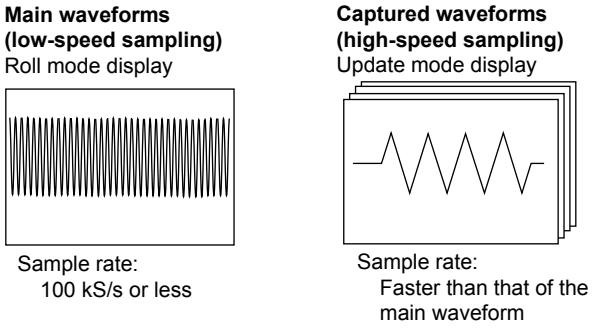
- **Zone Search**

  The DL850/DL850V searches for history waveforms that passed (or did not pass) through a specified search zone.
- **Waveform Parameter Search**

  The DL850/DL850V searches for waveforms whose measured waveform parameter values meet (or do not meet) specified conditions.

Dual Capturing

You can use dual capturing to simultaneously record a trend at a low sampling speed in roll mode and at a high sampling rate. This is useful for capturing fast phenomenon while observing a trend over a long period of time.



Waveform Display

The DL850/DL850V has a main window for displaying normal time-domain waveforms, zoom windows for displaying zoomed time-axis waveforms, and X-Y windows for displaying X-Y waveforms. In addition, you can split screens and change the sizes of waveform display areas so that waveforms and measured values are easier to see and display an FFT window that shows the results of FFT analysis.

Zooming along the Time Axis (GIGAZoom)

You can magnify displayed waveforms along the time axis. The zoomed waveforms of two locations can be displayed simultaneously (the dual zoom feature). This feature is useful when you set a long acquisition time and want to observe a portion of the waveform closely.

Displaying X-Y Waveforms

You can observe the correlation between two waveform signal levels by displaying one signal level on the X-axis (horizontal axis) and a second signal level on the Y-axis (vertical axis). You can display X-Y waveforms at the same time as normal T-Y (time and signal level) waveforms. You can display up to four overlapping X-Y waveforms in both Window1 and Window2. Because multiple X-Y waveforms can be displayed, it is easy to compare the relationships between phases. You can use this feature to evaluate DC motors using Lissajous waveforms.

Snapshot

You can continue displaying a waveform on the screen as a snapshot waveform after the screen has been updated and the waveform has been cleared in update mode or after the waveform has left the screen in roll mode. Snapshot waveforms appear in white. You can compare them with new waveforms. You can also save and print snapshot waveforms as screen captures.

Waveform Computation and Analysis

Waveform Computation

You can perform basic arithmetic, binarization, FFT (power spectrum), and phase shifting (display the waveform with its phase shifted). On models with the /G2 option, you can use a rich variety of functions (square root, trigonometric functions, differentiation, integration, digital filtering, six types of FFT functions, and so on) to define up to eight equations.

Cursor Measurement

There are cursors for T-Y (time-axis), X-Y, and FFT waveforms. You can position a cursor over a waveform to view the various measured values at the intersection of the cursor and the waveform.

Automated Measurement of Waveform Parameters

You can use this feature to automatically measure waveform levels, maximum values, frequencies, and other values. For up to 100 Mpoint of waveform data, you can measure 29 waveform parameters (including the delay between channels) that relate to the voltage axis, time axis, and waveform area.

- You can display a total of 32 measured values for all the waveforms.
- You can save a total of 64000 items of data for all the waveforms.
- You can also perform computations on measured waveform parameter values.
- You can display the following statistics for the specified waveform parameter.
  The maximum value (Maximum), minimum value (Minimum), average value (Average), standard deviation (SDev), and number of measured values used to calculate statistics (Count)

There are three statistical processing methods:

- **Normal statistical processing**

  While acquiring waveforms, the DL850/DL850V measures the measurement items and calculates the statistics of the waveforms that it has acquired so far.
- **Cyclic statistical processing (measurement and statistical processing are performed for each period)**

  The DL850/DL850V divides the waveform into periods starting at the left side of the screen (the oldest waveform) and moving to the right side of the screen, measures the selected measurement items within each period, and performs statistical processing on the measurement items.
- **Statistical processing of history waveforms**

  The DL850/DL850V measures the measurement items and calculates the statistics of history waveforms. Measurement and statistical processing begin with the oldest waveform.

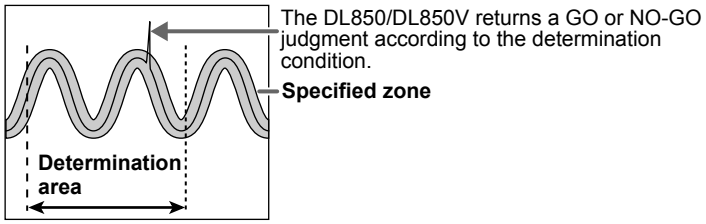
GO/NO-GO Determination

This feature is useful for signal testing on production lines and for tracking down abnormal phenomena. The DL850/DL850V determines whether the waveform enters the specified range. When the DL850/DL850V returns a GO (or NO-GO) result, specified actions are performed.

Determination Methods

- **Waveform Zone**

  The DL850/DL850V returns GO/NO-GO results based on whether waveforms leave or enter the zone that you create using a base waveform.


The DL850/DL850V returns a GO or NO-GO judgment according to the determination condition.
Specified zone
Determination area

- **Waveform Parameter**

  Set the upper and lower limits for automated measurement values of waveform parameters. The DL850/DL850V performs GO/NO-GO determination based on whether the values are within or outside of the limits.

Actions Performed according to Determination Results

The DL850/DL850V can print and save screen captures, save waveform data, beep, and send e-mails according to the results of GO/NO-GO determination.

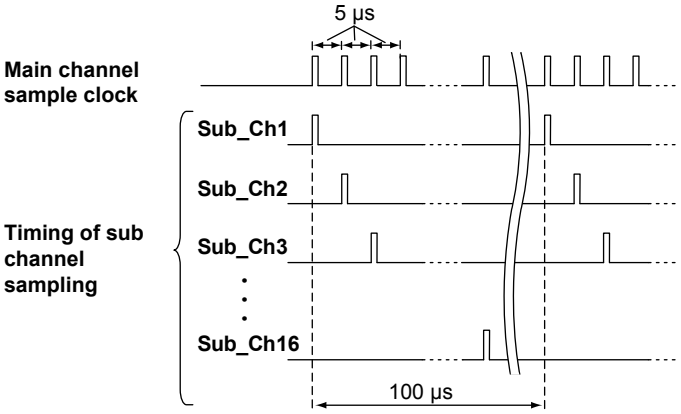
Notes about Using the 16-CH Voltage Input Module

While normal voltage input modules have two main channels for analog input, the 16-CH Voltage Input Module has 16 sub channels for analog input. The 16-CH Voltage Input Module samples the measured sub channels in order.

Main channel sample rate: 200 kS/s

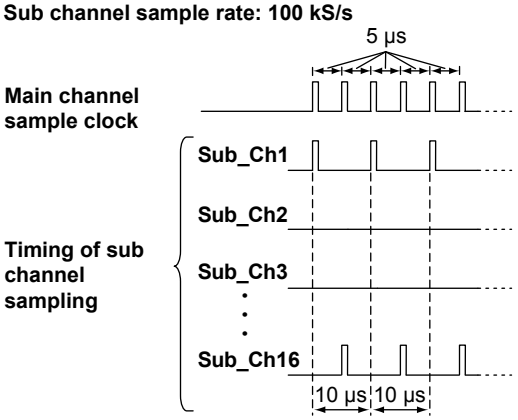
When the number of measured sub channels is 16 (all the sub channels are measured)

Sub channel sample rate: 10 kS/s



When the number of measured sub channels is 2 (sub channels 1 and 16 are measured)

Sub channel sample rate: 100 kS/s



- The 16-CH Voltage Input Module only uses the odd main channels of the slot that it is inserted into. It cannot use the slot's even main channels.
- If you do not want to measure an individual sub channel, turn its input coupling off. Sub channels whose input coupling has been turned off are not scanned.
- The maximum sample rate of the 16-CH Voltage Input Module is 200 kS/s (when only one sub channel is measured). The maximum sample rate per sub channel varies depending on the main channel sample rate and the number of measured sub channels. For information about sample rates, see appendix 1 in the *Getting Started Guide*, IM DL850-03EN.
- The sample rate that is displayed on the screen is the sample rate of the main channel.
- The record length of each sub channel varies depending on the set record length and the number of measured sub channels.

  Record length of each sub channel ≤ set record length/number of measured sub channels
- The timing of waveform acquisition is different for each sub channel, but all the sub channels are stored in the acquisition memory as if they had been sampled at the same timing. This means that the sampling times of the acquired waveform data are different from the sampling times of the actual applied waveforms.
- Because the waveform data stored in the acquisition memory is used to display waveforms on the screen, the data of all sub channels is displayed as if though it were sampled at the same timing.

- The following operations are performed on the waveform data stored in the acquisition memory: waveform zooming, cursor measurement, the automated measurement of waveform parameters, computation, FFT, waveform searches, and the loading and saving of waveform data.
- GO/NO-GO determination and the display and searching of history waveforms are not performed on sub channels.
- When you execute auto setup on the 16-CH Voltage Input Module, sub channel on/off settings and settings that relate to the horizontal axis (TIME/DIV) are not changed.
- Wire all the L input terminals for all the sub channels on the same module to the same potential. The L input terminals of the sub channels are common. Because the L input terminals are electrically connected inside the DL850/DL850V, connecting different potentials to them could result in short circuiting and damage to the 16-CH Voltage Input Module.
  For information about the terminal arrangement, see section 3.13 in the *Getting Started Guide*, IM DL850-03EN.
- For information about attaching and removing the terminal block and connecting and removing wires from the terminal block, see section 3.13 in the *Getting Started Guide*, IM DL850-03EN.

2 Vertical Axis

This section explains how to configure the signal input settings and the amplitude-direction display settings. The items that can be set vary depending on the installed modules.

Input Settings

CH1 to CH16

The channel menu that corresponds to the key you pressed appears. You can set the various vertical axis settings for each channel.

ALL CH

You can configure the settings of all channels while viewing the settings in a list. You can also copy the various vertical axis settings of one channel to another channel. There are some items that cannot be configured from the ALL CH list.

▶ See here.

DL850/DL850V Measurement Items

When the DL850/DL850V is equipped with the modules listed below, it can measure voltage, temperature, strain, acceleration, frequency, logic, CAN bus signals, and so on.

- **Voltage measurement**
  701250 (HS10M12), 701251 (HS1M16), 701255 (NONISO_10M12), 701260 (HV (with RMS)), 720210 (HS100M12), 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), 701265 (TEMP/HPV), 701275 (ACCL/VOLT)
- **Voltage measurement (for the 16-CH Voltage Input Module)**
  720220 (16CH VOLT)
- Temperature measurement
  701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), 701265 (TEMP/HPV)
- **Strain measurement**
  701270 (STRAIN_NDIS), 701271 (STRAIN_DSUB)
- **Acceleration measurement**
  701275 (ACCL/VOLT)
- **Frequency measurement**
  701280 (FREQ)
- **Logic measurement**
  720230 (LOGIC)
- **CAN Bus Signal Monitoring**
  720240(CAN MONITOR)
  This module can only be used with the DL850V.

You can use auto setup to automatically configure the appropriate settings (such as vertical axis, horizontal axis, and trigger settings) for the input signal. This feature is useful when you are not sure what type of signal will be applied to the DL850/DL850V. The auto setup feature will not work properly on some input signals. Also, there are some modules with which the auto setup feature cannot be used.

▶ See here.

Voltage Measurement

For voltage measurement, the items that have to be set for each input signal (CH1 to CH16) include vertical scales, the vertical positions, input coupling, probe attenuation, the bandwidth limit, the zoom method, the offset, waveform inversion, trace settings, and linear scaling.

You can measure voltage by connecting probes, measurement leads, etc. to one of the following voltage measurement modules: 701250 (HS10M12), 701251 (HS1M16), 701255 (NONISO_10M12), 701260 (HV (with RMS)), 720210 (HS100M12), 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), 701265 (TEMP/HPV), 701275 (ACCL/VOLT).

For the probe connection method, see section 3.5 in the *Getting Started Guide*, IM DL850-03EN. For the measurement lead connection method, see section 3.7.

- Waveform Display (Display)
- Labels (Label)
- Vertical Scale (SCALE knob)
- Waveform Vertical Position (Vertical POSITION knob)
- Input Coupling (Coupling)
- Probe Attenuation and Current-to-Voltage Conversion Ratio (Probe)
- Bandwidth (Bandwidth)
- Zoom Method (V Scale)
- Zooming by Setting a Magnification (V Zoom)
- Zooming by Setting Upper and Lower Display Limits (Upper/Lower)
- Offset (Offset)
- Trace Settings (Trace Setup)
- Inverted Waveform Display (Invert)
- Linear Scaling (Linear Scale)
- RMS Measurement

Waveform Display (Display)

Select whether to display each channel's input signal waveform.

- ON: Displays the waveform
- OFF: Does not display the waveform

Labels (Label)

You can specify a name of up to eight characters in length for each channel.

You can set whether to display labels using the DISPLAY menu.

▶ See here.

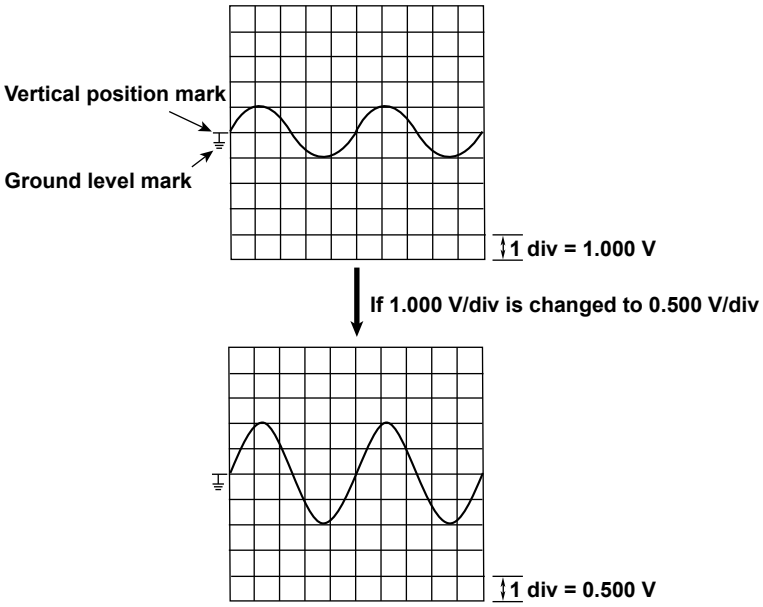
- The waveform display on/off setting changes to the waveform acquisition on/off setting in cases such as during hard disk recording and when an increase in the record length places a limitation on the number of channels that can be used.
- The specified display label is used in labels, scale values, the numeric display, and cursor-measurement values.
- Depending on the display and zoom formats, label names may not appear when the waveform display is narrow.

Vertical Scale (SCALE knob)

Voltage Scale Setting

The vertical scale is used to adjust the displayed waveform amplitude so that you can easily view signals. Set the vertical scale by voltage per grid square (V/div) or current per grid square (A/div) on the screen.
Use the SCALE knob to set the vertical scale for each channel and sub channel.
The same SCALE knob is used to adjust the scale of each channel and sub channel.
To change the vertical scale of a channel, press the key from CH1 to CH16 that corresponds to the channel.
To change the vertical scale of a sub channel, press an odd channel key from CH1 to CH15, and then press the soft key that corresponds to the sub channel.
The vertical scale changes when you switch to an input attenuator with a different attenuation. You can change the scale in steps like this: 1 V/div -> 2 V/div -> 5 V/div.

Example



- While waveform acquisition is stopped, turning the SCALE knob will not change the displayed waveform. The changed V/div value will be applied the next time that waveform acquisition is started.
- While waveform acquisition is stopped, turning the SCALE knob will not change the cursor-measurement values or the automated measurement values of waveform parameters, they will continue to be based on the V/div value at the time of measurement.

Selectable range of V/div

The selectable range varies as shown below depending on the input module.

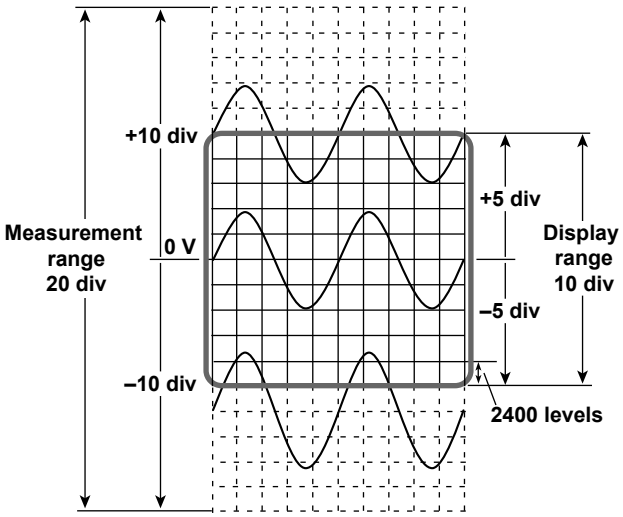
Input Module	Selectable Range
701250 (HS10M12)	5 mV/div to 20 V/div
701251 (HS1M16)	1 mV/div to 20 V/div
701255 (NONISO_10M12)	5 mV/div to 20 V/div
701260 (HV (with RMS))	20 mV/div to 200 V/div
701261 (UNIVERSAL)	5 mV/div to 20 V/div
701262 (UNIVERSAL (AAF))	5 mV/div to 20 V/div
701265 (TEMP/HPV)	0.1 mV/div to 10 V/div
701275 (ACCL/VOLT)	5 mV/div to 10 V/div
720210 (HS100M12)	10 mV/div to 20 V/div
720220 (16CH VOLT)	200 mV/div to 2 V/div

These values are for when the probe attenuation is 1:1. Multiply the values by 10 when the attenuation is 10:1, by 100 when the attenuation is 100:1, and by 1000 when the attenuation is 1000:1.

Measurement and Display Ranges

The measurement range of the DL850/DL850V is ±10 div, with 0 V in the center (the absolute width, or span, is 20 div). The default display-range setting is ±5 div (the span is 10 div). Using the features listed below, you can move and scale the displayed waveform so that parts of it that were outside of the display range are displayed.

- Vertical position adjustment
- Offset voltage setting
- Vertical zoom



- **How to Measure the Voltage with High Accuracy**
  To measure the voltage with high accuracy, increase the vertical scale so that the input signal is measured with the largest possible amplitude. To display multiple waveforms so that they do not overlap without dividing the screen, you have to set the vertical scale to a low value. This prevents you from taking advantage of the A/D converter's resolution. However, if you divide the screen and arrange the waveforms in the divided screens, they will not overlap, and you can raise their vertical scales.
- **Measurement Resolution**
  The measurement resolution varies depending on the module. For example, the 701250 (HS10M12), 701255 (NONISO_10M12), and 720210 (HS100M12) use 12-bit A/D converters and sample the input signal at a resolution of 150 levels per div. The 701251 (HS1M16), 701260 (HV (with RMS)), 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), 701265 (TEMP/HPV), 701275 (ACCL/VOLT), and 720220 (16CH VOLT) use 16-bit A/D converters and sample the input signal at a resolution of 2400 levels per div.

Waveform Vertical Position (Vertical POSITION knob)

The DL850/DL850V can display the waveforms of the main analog-input channels, the waveforms of the sub analog-input channels, and computed waveforms. Because the DL850/DL850V can display so many waveforms, the waveforms may overlap and be difficult to view. If this happens, you can adjust the vertical display position to make waveforms easier to view (vertical position).

The vertical position can be moved within the range of ±5 div.

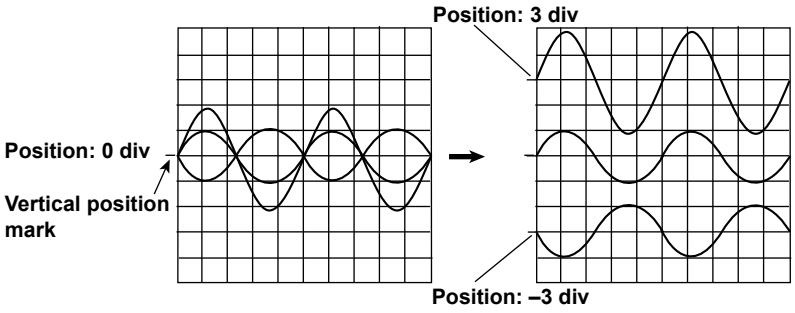
When you change the vertical scale (V/div), the location of the vertical position mark does not change.

Use the POSITION knob to set the vertical position for each channel and sub channel.

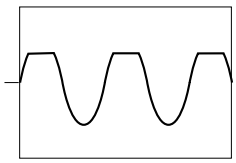
The same POSITION knob is used to adjust the position of each channel and sub channel.

To change the position of a channel, press the key from CH1 to CH16 that corresponds to the channel.

To change the position of a sub channel, press an odd channel key from CH1 to CH15, and then press the soft key that corresponds to the sub channel.



- You cannot use the vertical POSITION knob to move the vertical position of a temperature, strain, or computed waveform.
- When the menu for configuring all channels (ALL CH) or all sub channels (ALL Sub Channels Setup) is displayed, you can use the job shuttle to change the vertical positions.
- When you change the vertical position, offset voltage, or upper or lower limit (when Variable is set to ON), data that is outside of the measurement range is handled as overflow data. As shown in the figure below, waveforms appear cut off when there is overflow data.



Input Coupling (Coupling)

It is easier to measure the amplitude of an AC signal if you remove its DC component. On the other hand, there are times when you want to measure the ground level or observe the entire signal, including both the DC and AC components. In these kinds of situations, you can change the input coupling setting. By changing the setting, you can choose how the vertical-axis (voltage-axis) control circuit is coupled to the input signal. You can set the input coupling to one of the options listed below.

DC

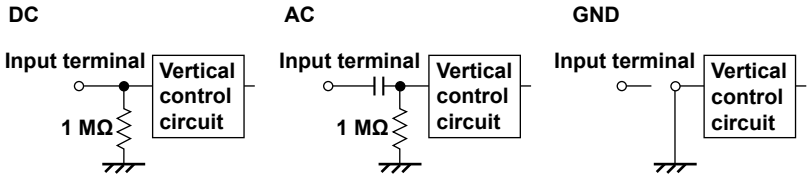
The input signal is coupled directly to the attenuator of the vertical control circuit. Set the input coupling to DC when you want to measure the entire signal, including both the DC and AC components.

AC (Only when measuring AC voltage)

The input signal is coupled to the attenuator of the vertical control circuit through a capacitor. Set the input coupling to AC when you want to measure only the amplitude of the AC signal without the DC component.

GND

The input signal is coupled to the ground rather than to the attenuator of the vertical control circuit. Set the input coupling to GND to check the ground level on the screen.



TC (Only when measuring temperature)

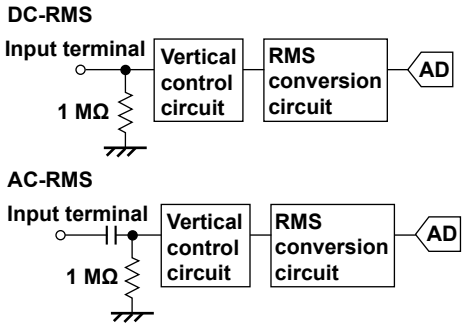
Set the coupling to TC when you are measuring temperature using the 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), or 701265 (TEMP/HPV).

DC-RMS

With the 701260 (HV (with RMS)), the DC and AC components of the input signal are converted to RMS values and displayed. An RMS conversion circuit is connected to the same vertical-control-circuit coupling arrangement that is used when the coupling is set to DC.

AC-RMS

With the 701260 (HV (with RMS)), the AC components of the input signal are converted to RMS values and displayed without the DC component. An RMS conversion circuit is connected to the same vertical-control-circuit coupling arrangement that is used when the coupling is set to AC.



ACCEL (Only when measuring acceleration)

To measure acceleration with the 701275 (ACCL/VOLT), set the input coupling to ACCEL.

OFF (only for the 16-CH Voltage Input Module)

Set the coupling to OFF to not include the sub channels selected on the 720220 (16CH VOLT) in the measurement.

Probe Attenuation and Current-to-Voltage Conversion Ratio (Probe)

In voltage (current) measurement, a probe is used to connect the circuit under measurement to a signal input terminal. Using a probe has the following advantages.

- Prevents the disturbance of the voltage and current of the circuit being measured.
- Allows signals to be applied with no distortion.
- Expands the voltage (current) range that the DL850/DL850V can measure.

When you use a probe, to read the measurement voltage (current) correctly, you must set the attenuation on the DL850/DL850V to match the probe attenuation or current-to-voltage conversion ratio.

Set the attenuation ratio as indicated below for each probe. (The probes are optional accessories that are sold separately.)

Probe Type	Attenuation
Isolated probe (700929)	10:1
Isolated probe (701947)	100:1
Current probe (701933)	10 A:1 V
Current probes (701930, 701931)	100 A:1 V
Differential probe (700924)	1000:1, 100:1
10:1 passive probe (701940)	10:1

The attenuation settings available on the DL850/DL850V are 1:1, 10:1, 100:1, 1000:1, 10 A:1 V[1], and 100 A:1 V[2]. If you use a probe other than one of the separately sold optional accessories provided by Yokogawa, set the attenuation ratio in accordance with that probe.

1 Output voltage rate: 0.1 V/A

2 Output voltage rate: 0.01 V/A

Use a probe that is appropriate for the input capacitance of the module that you are using it with. The capacitance cannot be adjusted for an inappropriate probe.

Bandwidth (Bandwidth)

You can specify a bandwidth limit for each module. You can use bandwidth limits to observe input signal waveforms with their noise components removed.

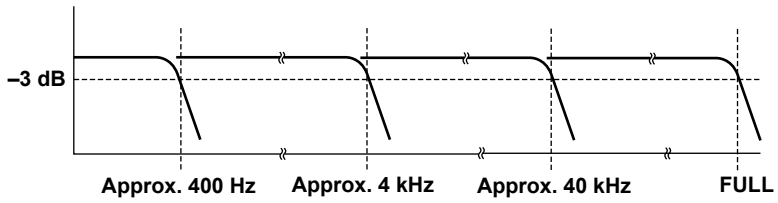
Normal Bandwidth Limits

You can remove high-frequency components from the input signal. The bandwidth limits vary as shown below depending on the input module.

Input Module	Bandwidth Limit
701250 (HS10M12) 701255 (NONISO_10M12)	500 Hz, 5 kHz, 50 kHz, 500 kHz, Full
701251 (HS1M16)	400 Hz, 4 kHz, 40 kHz, Full
701260 (HV (with RMS))	100 Hz, 1 kHz, 10 kHz, Full
720210 (HS100M12)	10 kHz, 20 kHz, 40 kHz, 80 kHz, 160 kHz, 640 kHz, 1.28 MHz, 2 MHz, Full
720220 (16CH VOLT)	500 Hz, Full
701261 (UNIVERSAL)[1] 701262 (UNIVERSAL (AAF))[1] 701265 (TEMP/HPV)	2 Hz, 8 Hz, 30 Hz, Full
701270 (STRAIN_NDIS) 701271 (STRAIN_DSUB)	10 Hz, 100 Hz, 1 kHz, Full
701261 (UNIVERSAL)[2] 701262 (UNIVERSAL (AAF)) 701275 (ACCL/VOLT)	40 Hz, 400 Hz, 4 kHz, Auto, Full
701280 (FREQ)[3]	100 Hz, 1 kHz, 10 kHz, 100 kHz, Full

1 When measuring temperature.
2 When measuring voltage. Auto cannot be selected on the 701261.
3 Full cannot be selected when Preset is set to AC100V or AC200V.

For example, on the 701251 (HS1M16), you can set the bandwidth limit to 400 Hz, 4 kHz, or 40 kHz. The frequency characteristics for the different bandwidth limits are shown below. If you select Full, the module's maximum bandwidth is used.



Bandwidth Limitation on the 701262 (UNIVERSAL (AAF)) and the 701275 (ACCL/VOLT)

When you are measuring voltage using the 701262 (UNIVERSAL (AAF)) or when you are using the 701275 (ACCL/VOLT) and the bandwidth is set to Auto, the anti-aliasing and low-pass filter settings vary as shown below depending on the sample rate.

Sample Rate	Anti-Aliasing Filter	Low-Pass Filter
200 kS/s or greater	40 kHz	OFF
100 kS/s	40 kHz	OFF
50 kS/s	20 kHz	OFF
20 kS/s	8 kHz	OFF
10 kS/s	4 kHz	4 kHz
5 kS/s	2 kHz	4 kHz
2 kS/s	800 Hz	4 kHz
1 kS/s	400 Hz	400 Hz
500 S/s	200 Hz	400 Hz
200 S/s	80 Hz	400 Hz
100 S/s	40 Hz	40 Hz
50 S/s	20 Hz	40 Hz
5 S/s to 20 S/s	20 Hz	40 Hz
2 S/s or less	20 Hz	40 Hz
Ext sample	40 kHz	OFF

For example, when the sample rate is between 100 kS/s and 50 kS/s, the cutoff frequency of the anti-aliasing filter is 40% of the sample rate.

Zoom Method (V Scale)

You can choose the method for zooming the waveform vertically.

- DIV: The waveform is zoomed by a set magnification.
- SPAN: The waveform is zoomed to fit within specified upper and lower display limits.

Zooming by Setting a Magnification (V Zoom)

When V Scale is set to DIV, you can set the vertical magnification and enlarge or reduce the waveform along the vertical axis. This method is useful when you want to change the vertical scale of the waveform after it has been displayed.

Zoom Factor (V Zoom)

The magnifications that you can choose from are listed below.
x0.1, x0.111, x0.125, x0.143, x0.167, x0.2, x0.25, x0.33, x0.4, x0.5, x0.556, x0.625, x0.667, x0.714, x0.8, x0.833, x1, x1.11, x1.25, x1.33, x1.43, x1.67, x2, x2.22, x2.5, x3.33, x4, x5, x6.67, x8, x10, x12.5, x16.7, x20, x25, x40, x50, x100

The range of zoom magnifications that you can choose varies under special circumstances as described below.

When using the 701260 (HV (with RMS))

50 V/div: x0.25 to x100
100 V/div: x0.5 to x100
200 V/div: x1 to x100

When measuring acceleration using the 701275 (ACCL/VOLT)

x0.5 to x50

When using the 701280 (FREQ)

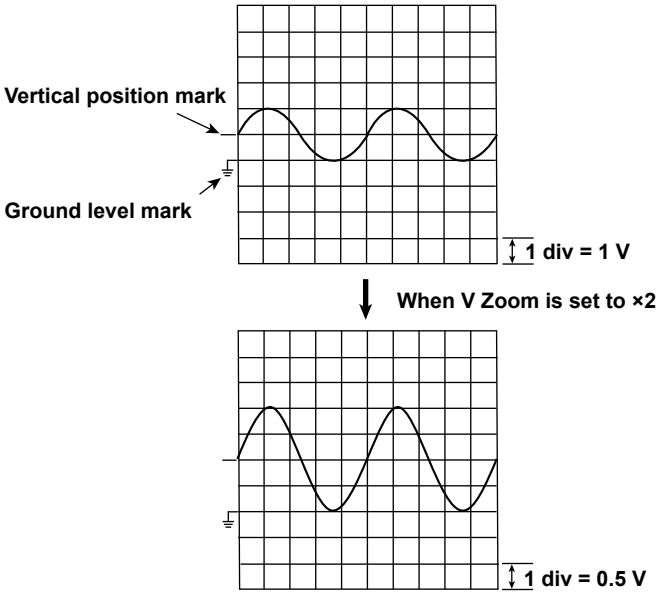
x0.33 to x100

When using the 720230 (LOGIC)

x0.1 to x3.33

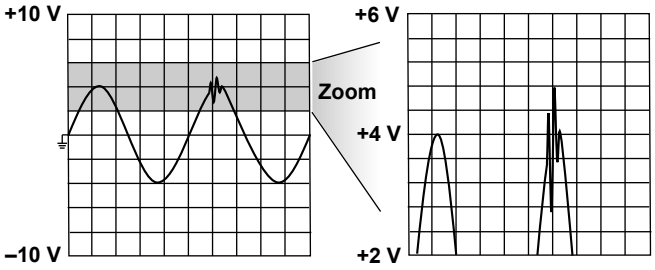
Zoom Position

Zooming is centered on the vertical position.



Zooming by Setting Upper and Lower Display Limits (Upper/Lower)

When V Scale is set to SPAN, you can set the upper and lower vertical limits and enlarge or reduce the waveform along the vertical axis. By setting the appropriate upper and lower limits for the displayed waveform, you can zoom in vertically on the area of the waveform that you want to observe. You can also increase the display range to view parts of the waveform that were outside the range. Zooming the waveform does not change its A/D conversion resolution or accuracy.



Selectable Range of the Upper and Lower Limits

The upper and lower limits can be set within ±(100 × the specified V/div value) or ±2000 V, whichever is lower. Set the limits so that the upper limit is greater than the lower limit.

- The range of the upper and lower limits for the 701270 (STRAIN_NDIS) and 701271 (STRAIN_DSUB) varies as indicated below depending on the range unit.
  When the range unit is μSTR: ±30000 μSTR
  When the range unit is mV/V: ±15 mV/V
- For the 701275 (ACCL/VOLT), the range of the upper and lower limits is ±2000000 units.
- For the 701280 (FREQ), the range of the upper and lower limits is (offset) ± (Value/div × 30).
  When measuring frequencies: −1500 kHz to 1700 kHz
  When measuring revolutions in rpm: −300 krpm to 350 krpm
  When measuring revolutions in rps: −5000 rps to 7000 rps
  When measuring periods: −150 s to 200 s
  When measuring duty ratios: −500% to 700%
  When measuring pulse widths: −150 s to 200 s
  When measuring pulse integration: −2.5E+22 to 2.5E+22
  When measuring velocity: −2.5E+22 to 2.5E+22

The displayed V/div will not change if you turn the SCALE knob after you set the upper and lower limits, but the measurable range will change. If you change the measurable range so that it is narrower than the range of the set upper and lower limits, when you start waveform acquisition, the parts of the waveform that do not fit within the measurable range may not appear. The measurable range is approximately ±10 div (with 0 in the center) when V Scale is set to DIV.

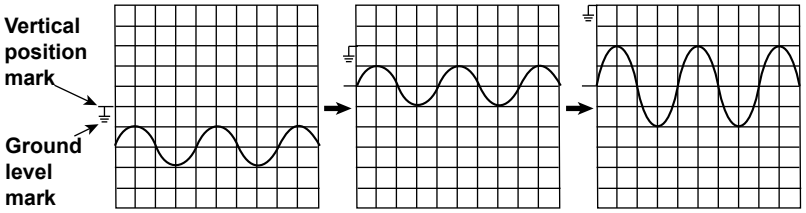
Offset (Offset)

By adding an offset, you can move the waveform to a vertical position that is easier to see. For example, when measuring a signal with a fixed voltage component, you can use the offset to cancel out the fixed voltage and measure the signal changes at a higher voltage sensitivity.

You can set the offset for each channel.

The offset is useful when you are measuring voltage or using the frequency module to measure frequency or some other value.

Voltage sensitivity:	**1.000 V/div**	**1.000 V/div**	**0.500 V/div**
Vertical position:	**0.00 div**	**1.00 div**	**1.00 div**
Offset voltage:	**0.000 V**	**–2.000 V**	**–2.000 V**



Selectable Range of the Offset

When measuring voltage: ±5 div

For the frequency module, the range varies depending on what is being measured.

- When measuring frequency: ±(Value/div) × 1000 or 200 kHz
- When measuring revolutions in rpm: ±(Value/div) × 1000 or 50 krpm
- When measuring revolutions in rps: ±(Value/div) × 1000 or 1000 rps
- When measuring periods: ±(Value/div) × 1000 or 50 s
- When measuring duty ratios: ±(Value/div) × 1000 or 100%
- When measuring pulse widths: ±(Value/div) × 1000 or 50 s
- When measuring pulse integration: ±(Value/div) × 1000 or 1.0000E+22
- When measuring velocity: ±(Value/div) × 1000 or 1.0000E+22

Notes about Setting the Offset

- When you are measuring voltage, changes to the offset are applied when acquisition is stopped. When you are measuring the frequency or some other value using the frequency module, changes to the offset are not applied when acquisition is stopped. The changed offset will be applied to the next measurement.
- When you are measuring voltage, if you change the probe attenuation, the offset voltage is determined using the new attenuation ratio.
- When you are measuring voltage, the offset will not change even if you change the voltage scale. However, if the offset goes outside the selectable range, the offset is set to the maximum or minimum value for the current voltage scale. If you set the vertical scale back to its original value without changing the offset, the offset returns to its original value.

- The offset does not affect cursor-measurement values, automated measurement values of waveform parameters, or computed values.
- You can change the position of the waveform relative to the vertical position (change the focus of the vertical zoom) by changing the offset.

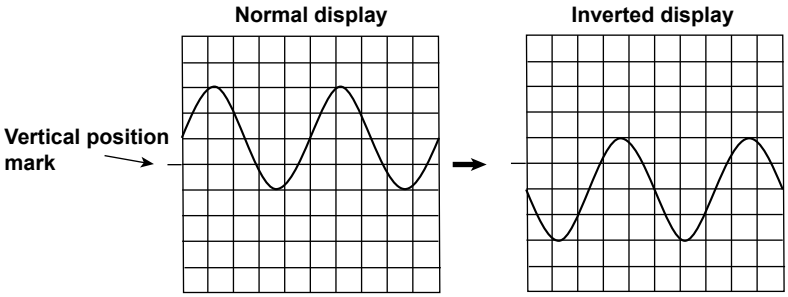
Trace Settings (Trace Setup)

These settings are the same as the display assignment and display color settings in the DISPLAY menu.

▶ See here.

Inverted Waveform Display (Invert)

When measuring voltage and strain, you can invert the waveform display around the vertical position.



- Cursor measurements, automated measurements of waveform parameters, and computations are performed on the inverted waveforms.
- Even when inverted waveforms are displayed, triggering is based on the uninverted waveforms.
- When you are measuring strain, you cannot invert waveforms whose measurement has finished. The inversion setting will be applied when the next measurement starts.

Linear Scaling (Linear Scale)

Linear scaling is a function that converts measured values into physical values and reads them directly. When you measure voltage (current), strain, or frequency (revolutions, periods, duty ratios, power supply frequencies, pulse widths, pulse integration, velocities), you can choose from one of two linear scaling methods: AX + B or P1-P2.

Linear Scaling Modes (Scaling Mode)

- **OFF**

  Linear scaling is not performed.

- **AX + B**

  Using specified scaling coefficient A and offset B, the DL850/DL850V performs the following computation to scale cursor-measurement values and automated measurement values of waveform parameters. You can specify the unit of the linearly scaled results.

  Y = AX + B

  X: Value before scaling

  Y: Value after scaling

  Selectable range for A and B: −9.9999E+30 to +9.9999E+30

  Initial value of A: +25.000E+00

  Initial value of B: −25.000E+00

- **P1-P2**

  You can specify two measured values (P1:X, P2:X) and specify a scale value (P1:Y, P2:Y) for each. The scale-conversion equation (y = ax + b) is determined by these four values.

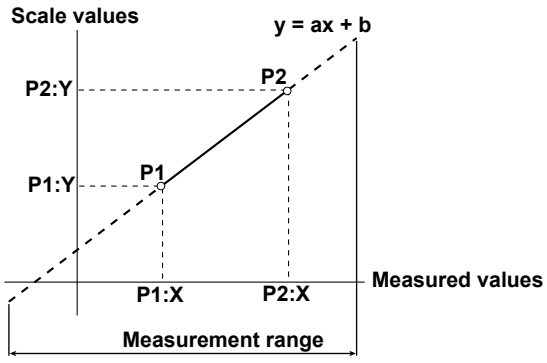
  - Measured value (P1:X, P2:X) range: Same as the measurement range
  - Scale value (P1:Y, P2:Y) range: −9.9999E+30 to +9.9999E+30
  - Initial scale values

    P1:X +0.0000E+00, P1:Y +0.0000E+00

    P2:X +5.0000E+00, P2:Y +100.0000E+00

  Get Value (Get Value)

  Sets P1:X and P2:X to the current values (the values displayed by the level indicator), regardless of whether waveform acquisition is in progress or stopped.



Unit String (Unit String)

You can set the unit using up to four alphanumeric characters.

Display Type (Display Type)

When you measure voltage using a voltage module or measure strain using a strain module, you can display the linearly scaled results using one of the following two methods.
Exponent: Values are displayed in exponential notation.
Floating: Values are displayed as decimal numbers.

For Decimal Number, set the number of digits after the decimal point to Auto or a number from 0 to 3. For SubUnit, set the unit prefix to Auto, p, n, µ, m, None, k, M, G, or T.

- If you set Decimal Number to a number from 0 to 3, the specified number of digits after the decimal point are displayed. If you select Auto, all numbers will be displayed using five digits (for example: 1.0000, 250.00). The default setting is Auto.
- If you set SubUnit to a setting other than Auto, numbers will be displayed with the specified unit prefix. If you select Auto, the DL850/DL850V will automatically select appropriate unit prefixes. The default setting is Auto. The DL850/DL850V displays values in exponential notation if it is unable to display them as decimal numbers.

Scale Value Display

You can display the linearly scaled values of the upper and lower vertical limits of each channel.
You can turn the scale value display on and off in the DISPLAY menu.

▶ See here.

- Linear scaling cannot be performed for measurements of temperature or acceleration.
- The following waveforms cannot be linearly scaled.
  Accumulated waveforms (except for the most recent)
- You can configure linear scaling for each channel.
- The specified scaling coefficient A and offset B are retained even after linear scaling is set to OFF.
- Computations are performed on the linearly scaled values.

RMS Measurement

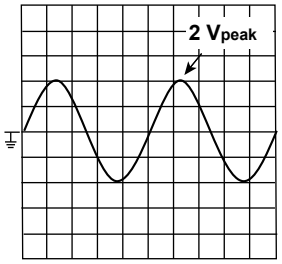
When the selected channel belongs to the 701260 (HV (with RMS)), you can observe the RMS values of the input signal.

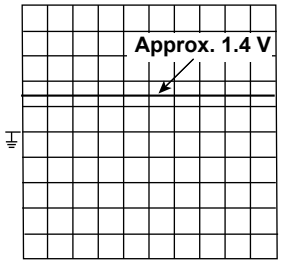
AC-RMS

Use this setting when you only want to observe the RMS values of the input signal without the DC component.

Example

When you measure the RMS values of a 2 Vpeak sine wave, an approximately 1.4 VDC signal appears, as shown in the figure on the right.





RMS values are calculated using the following equation.

$$\sqrt{\frac{1}{T}\int_0^T u(t)^2\,dt}$$ **u(t): Input signal, T: One cycle of the input signal**

Given u(t) = Vmsinωt (where Vm is the peak value and ω is the angular velocity of 2πf, with f being the frequency of the sine wave signal), the RMS value Vrms is:

$$V_{rms} = \sqrt{\text{Average of } u(t)^2 \text{ over one cycle}} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi}(V_m \sin wt)^2\,dwt} = \frac{V_m}{\sqrt{2}}$$

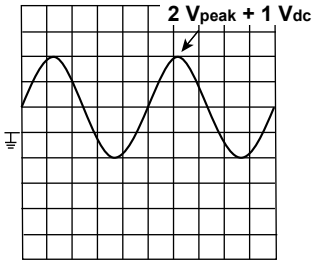
As shown in the example above, if Vm is 2 V, the RMS value Vrms is approximately 1.4 V.

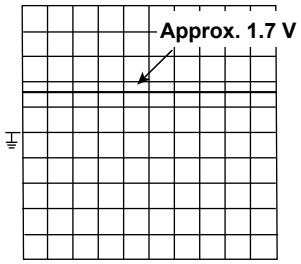
DC-RMS

Use this setting when you want to observe the RMS values of the entire signal, including both the DC and AC components.

Example

When you measure the RMS values of a 2 Vpeak sine wave with a 1 VDC component superimposed on it, an approximately 1.7 VDC signal appears, as shown in the figure on the right.





Given DC component Vdc and AC component u(t) = Vmsinωt, the RMS value Vrms (+ DC) of a sine wave signal with a DC component superimposed on it is:

$$V_{rms(+DC)} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi}(V_m \sin wt + V_{dc})^2\,dwt} = \sqrt{\left(\frac{V_m}{\sqrt{2}}\right)^2 + (V_{dc})^2}$$

As shown in the example above, if Vdc is 1 V and Vm is 2 V, the RMS value Vrms (+DC) is approximately 1.7 V.

In RMS measurement mode, when a signal with an AC component below 40 Hz is acquired, because of the characteristics of the RMS circuit, a ripple component is displayed, and the RMS values are not displayed properly. DC signals are measured properly.

Voltage Measurement (For the 16-CH Voltage Input Module)

When you measure voltages using the 16-CH Voltage Input Module, the items that you have to set for each input signal (sub channel 1 to sub channel 16) include vertical scales, the vertical positions, input coupling, the bandwidth limit, the zoom method, the offset, waveform inversion, trace settings, and linear scaling.
You can connect wiring to the input terminals of the 720220 16-CH Voltage Input Module (16CH VOLT) to measure voltages on 16 channels.
For information about how to connect the wiring, see section 3.13 in the *Getting Started Guide*, IM DL850-03EN.

Waveform Display (Display)

You can select whether to display each module's input signal waveforms. You can turn the display of each main channel (CH1, CH3, CH5, and CH7) on and off.

- ON: Displays the waveform
- OFF: Does not display the waveform

- The 16-CH Voltage Input Module only uses the odd main channels of the slot that it is inserted into. It cannot use the slot's even main channels.
- On the 16-CH Voltage Input Module, turning the display of a waveform on or off turns the displays of all of the module's sub channels on or off. To turn off the display of individual sub channels, turn off their input coupling.

Setting All Sub Channels (All SubChannels Setup)

You can configure the settings of all sub channels while viewing the settings in a list. You can also copy the various vertical axis settings of one sub channel to another sub channel. There are some items that cannot be configured from the All Sub Channels Setup list.

▶ See here.

Sub Channels 1 to 16 (Sub Channel 1 to 16)

The sub channel menu that corresponds to the key you pressed appears. You can set the various vertical axis settings for each sub channel.

Labels (Label)

▶ See here.

Vertical Scale (SCALE knob)

▶ See here.

Waveform Vertical Position (Vertical POSITION knob)

▶ See here.

Input Coupling (Coupling)

You can set the input coupling to DC, GND, or OFF. Sub channels whose coupling is set to OFF are not measured or displayed.

▶ See here.

Bandwidth (Bandwidth)

You can set the bandwidth limit to 500 Hz, or Full.

▶ See here.

Zoom Method (V Scale), Zooming by Setting a Magnification (V Zoom), Zooming by Setting Upper and Lower Display Limits (Upper/Lower)

▶ See here.

Offset (Offset)

▶ See here.

Trace Settings (Trace Setup)

▶ See here.

Inverted Waveform Display (Invert), Linear Scaling (Linear Scale)

▶ See here.

Setting All Sub Channels (All SubChannels Setup)

Input Settings (Setup)

You can configure the settings of all sub channels while viewing the settings in a list. The settings that you can view and configure are listed below.

Display color, label (Label), coupling (Coupling), vertical scale (V Scale), bandwidth limit (Band Width), zoom method (DIV/SPAN), offset (Offset), position (Position), magnification for zooming (V Zoom), display range limits for zooming (Upper/Lower)

Linear Scaling (Linear Scale)

You can configure the linear scaling settings of all sub channels while viewing the settings in a list. The settings that you can view and configure are listed below.

Linear scaling (Linear Scale); A and B for AX+B or P1:X, P1:Y, P2:X, and P2:Y for P1-P2; unit string (Unit); display mode (Disp Type); number of decimal places (Decim Num); unit prefix (Sub Unit)

Copy (Copy to)

You can copy the various vertical axis and linear scaling settings of one sub channel to another sub channel.

- **Source sub channel (Source Sub Channel)**

  You can set the source sub channel to a channel from channel 1 to 16.

- **Destination sub channel (DestinationSub Channel)**

  You can set the destination sub channels by using the following options.

  Select ALL ON to select all sub channels, select ALL OFF to unselect all sub channels, and select individual sub channels by selecting numbers 1 to 16.

- **Execute (Execute)**

  Select Execute to copy the settings.

The waveform display color and label settings are not copied.

Notes about Using the 16-CH Voltage Input Module

▶ See here.

Temperature Measurement

For temperature measurement, the items that have to be set for each input signal (CH1 to CH16) include vertical scales, the vertical positions, input coupling, thermocouple type, the bandwidth limit, trace settings, temperature settings, and the temperature unit.

You can connect a thermocouple to one of the temperature modules, 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), or 701265 (TEMP/HPV), and measure temperatures.

For information about how to connect thermocouples, see section 3.8 in the *Getting Started Guide*, IM DL850-03EN.

Waveform Display (Display)

Select whether to display each channel's input signal waveform.

- ON: Displays the waveform
- OFF: Does not display the waveform

Labels (Label)

▶ See here.

Input Coupling (Coupling)

Set the coupling to TC when you are measuring temperature using the 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), or 701265 (TEMP/HPV).

To measure voltage, set the input coupling to an appropriate voltage measurement setting.

▶ See here.

Thermocouple Type (Type)

Select the appropriate thermocouple type for thermocouple that you are using.

You can select thermocouple type from the options listed below.

When the input terminals are open, the displayed value is less than or equal to the lower limit of the measurement range.

Type	Measurement Range
K	−200 to 1300°C
E	−200 to 800°C
J	−200 to 1100°C
T	−200 to 400°C
L	−200 to 900°C
U	−200 to 400°C
R	0 to 1700°C
S	0 to 1700°C
B	400 to 1800°C
N	0 to 1300°C
W	0 to 2300°C
Au7Fe (AuFe-chromel)	0 to 300 K

Bandwidth (Bandwidth)

You can set the bandwidth limit to 2 Hz, 8 Hz, 30 Hz, or Full.

▶ See here.

Display Range (Upper/Lower)

To display the measured waveform on the screen, you need to set upper and lower display range limits that are appropriate for the input.

Maximum Range

- −5432 to 5432°C (when the resolution is 0.1°C)
- −5432 to 5432 K (when the resolution is 0.1 K)

The minimum span is 2°C (or 2 K).

Temperature Unit (Unit)

You can set the temperature unit to °C or K. The default setting is °C.

Trace Settings (Trace Setup)

▶ See here.

Reference Junction Compensation and Burnout (Temperature Setup)

Reference Junction Compensation (RJC)

The voltage produced by thermocouple is based on the temperature of the point that you are measuring and the temperature of the reference junction. Reference junction compensation (RJC) refers to the act of correcting for the temperature of the measuring instrument and using it as a cold junction.

On the DL850/DL850V, you can turn the internal RJC circuit on and off.

- ON: Select ON to use the RJC circuit to perform reference junction compensation.
- OFF: Select OFF to check measured temperature values or use an external reference junction (0°C).

Normally, you should perform measurements with RJC set to ON.

When you set RJC to OFF and apply a voltage that corresponds to a temperature t to an input terminal, if the measured temperature does not match temperature t, the DL850/DL850V or the module may be damaged. Contact your nearest YOKOGAWA dealer.

Burnout (Burn Out)

Sets the operation to perform when thermocouple detects a burnout (circuit break).

- ON: When a burnout is detected, the measured value is fixed at the upper limit of the measurement range of thermocouple.
- OFF: Burnouts are not detected.

The default setting is OFF.

Strain Measurement

For strain measurement, the items that have to be set for each input signal (CH1 to CH16) include vertical scales, sensor settings, the bandwidth limit, the display range, the range unit, trace settings, waveform inversion, and linear scaling.

To measure strain, connect a strain measurement bridge (bridgehead) or a strain gauge transducer to the 701270 (STRAIN_NDIS) or 701271 (STRAIN_DSUB) strain module.

For information about how to connect a bridgehead, see section 3.9 in the *Getting Started Guide*, IM DL850-03EN.

- Waveform Display (Display)
- Labels (Label)
- Vertical Scale (SCALE knob)
- Setting the Sensor (Sensor Setup)
- Performing Strain Balancing (Exec Balance)
- Bandwidth (Bandwidth)
- Display Range (Upper/Lower)
- Range Unit (Range Unit)
- Trace Settings (Trace Setup)
- Inverted Waveform Display (Invert)
- Linear Scaling (Linear Scale)
- About Shunt Calibration

Waveform Display (Display)

Select whether to display each channel's input signal waveform.

- ON: Displays the waveform
- OFF: Does not display the waveform

Labels (Label)

▶ See here.

Vertical Scale (SCALE knob)

You can select one of the following measurement ranges.

When µSTR Is Selected

500µSTR, 1000µSTR, 2000µSTR, 5000µSTR, 10000µSTR, 20000µSTR

For information about the measurement ranges, see section 6.13 in the *Getting Started Guide*, IM DL850-03EN.

When mV/V Is Selected

0.25 mV/V, 0.5 mV/V, 1 mV/V, 2.5 mV/V, 5 mV/V, 10 mV/V

For information about the measurement ranges, see section 6.13 in the *Getting Started Guide*, IM DL850-03EN.

The number that appears to the right of the range display is the maximum input at the current bridge voltage converted into a voltage value. It is the maximum input voltage for the selected range.

Setting the Sensor (Sensor Setup)

Bridge Voltage (Excitation)

You can select the voltage to apply to the bridgehead.

- 2V: When the bridgehead resistance (bridge resistance) is 120 Ω to 1000 Ω
- 5V*: When the bridge resistance is 350 Ω to 1000 Ω
- 10V*: When the bridge resistance is 350 Ω to 1000 Ω

You cannot change the bridge voltage during waveform acquisition.

* The bridge voltage can only be set to 5 V or 10 V when:

- The bridge resistance is 350 Ω or more
- The strain gauge transducer supports a bridge voltage of 5 V or 10 V

Gauge Factor (Gauge Factor)

You can set the gauge factor of the strain gauge.
Selectable range: 1.90 to 2.20 (in steps of 0.01)
The gauge factor is a constant that is unique to the gauge. It should be listed in the manual or other documentation for your gauge. You cannot change the gauge factor during waveform acquisition.

Gauge Factor When mV/V Is Selected (Gauge Factor: K)

On the DL850/DL850V, you can specify the gauge factor. If there is no recommended gauge factor for the strain gauge transducer, set the gauge factor to 2.00. For factors other than 2.00, e is computed with in the DL850/DL850V using the following equation.

$e = (4/K) \times (V/E)$

e: The measured value of the strain gauge transducer (mV/V).
V: The measured bridge voltage (V)
E: The applied bridge voltage (V)
K: The gauge factor

When you change the unit of a channel, the units for all the items related to the channel change.

- Upper and lower limits (Upper/Lower)
- Trigger level (Level)
- Automated measurement values of waveform parameters, cursor-measurement values, etc.

Performing Strain Balancing (Exec Balance)

You can automatically compensate for the unbalanced part of the bridge resistance. It takes a few seconds for balancing to be performed.
Range within which balancing is performed:

- ±10000 µSTR (when µSTR is selected)
- ± 5 mV/V (when mV/V is selected)

Bandwidth (Bandwidth)

You can set the bandwidth limit to 10 Hz, 100 Hz, 1 kHz, or Full.

▶ See here.

Display Range (Upper/Lower)

To display the measured waveform on the screen clearly, you can set upper and lower display range limits that are appropriate for the input.
Selectable range:

- −3.0000E+04 to +3.0000E+04 (when µSTR is selected)
- −1.5000E+01 to +1.5000E+01 (when mV/V is selected)

Set the limits so that the upper limit is greater than the lower limit.

Range Unit (Range Unit)

Set the range unit.

- µSTR: Units of strain ($\times 10^{-6}$ strain)
- mV/V: Units of strain-gauge-transducer output*

The default setting is units of strain (µSTR). The relationship between µSTR and mV/V is shown in the equation below.

(mV/V) = 0.5 × (µSTR)/1000

Example

500 (µSTR) -> 0.5 × 500 (µSTR)/1000 = 0.25 (mV/V)

* A unit that corresponds to the strain gauge transducer's output. It indicates the amount of transducer output in mV that corresponds to 1 V of applied bridge voltage. On the DL850/DL850V, the bridge voltage (excitation: applied bridge voltage) can be set to 2 V, 5 V, or 10 V, but the mV/V values are converted and displayed, so the measured values normally remain constant.

Trace Settings (Trace Setup)

▶ See here.

Inverted Waveform Display (Invert)

▶ See here.

Linear Scaling (Linear Scale)

▶ See here.

The 701271 (STRAIN_DSUB) supports shunt calibration.

- When you measure strain, be sure to perform balancing.
- Only set the bridge voltage to 5 V or 10 V when the bridge resistance is 350 Ω or greater. The strain will not be measured properly if you apply a bridge voltage of 5 V or 10 V when the bridge resistance is 350 Ω or less.
- When you use a strain gauge transducer, be sure to use it at a bridge voltage that is within the transducer's recommended voltage range.
- Balancing cannot be performed if there is no strain measurement bridge (bridgehead) or strain gauge transducer connected to the channel that you are trying to perform balancing on.
- When you perform balancing on all channels, if balancing fails on even one of the channels, an error message will appear along with information about the channels for which balancing failed.
- After you turn on the power, connect a new strain gauge, or change the measurement range, bridge voltage, or gauge factor, you need to perform balancing again before you perform measurement.
  The scale value is displayed as "imbalance" immediately after you turn on the power or when you change the range. In this kind of situation, perform balancing.
- When you change the unit of a channel, the units for all the items related to the channel change. This includes the upper and lower limits, trigger level, automated measurement values of waveform parameters, and cursor-measurement values.

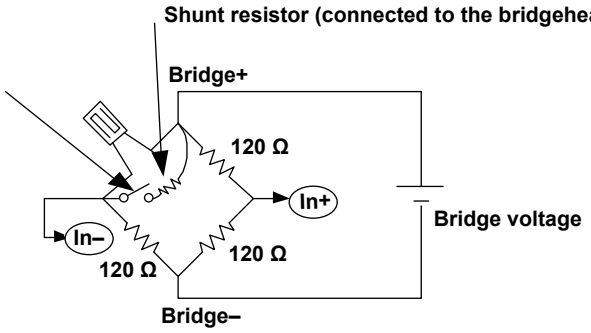
About Shunt Calibration (Only on the 701271(STRAIN_DSUB))

The 701271 (STRAIN_DSUB) strain module supports shunt calibration.

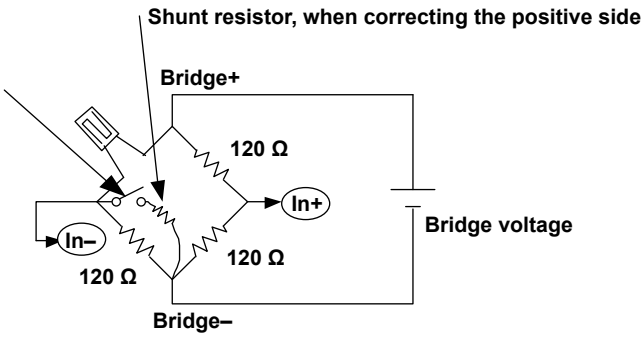
Shunt calibration is a type of scaling in which the strain measurement gain is adjusted through the connection in parallel of a known resistance (the resistance for shunt calibration, hereinafter referred to as the shunt resistance) to the strain gauge. The strain module (701271 (STRAIN_DSUB)) supports shunt calibration with a built-in shunt-calibration relay circuit.

To perform shunt calibration, you need a bridgehead that supports shunt calibration (the 701957 or 701958).

When correcting the gain on the negative side (normal)



When correcting the gain on the positive side



On the DL850/DL850V, in addition to performing normal shunt calibration (when the shunt-calibration relay circuit is on), you can also set the zero-point value when the relay circuit is off. The zero-point value is valid when the strain value after balancing is performed is not 0.

Linear Scaling Modes (Scaling Mode)

- **Shunt**

  Select this mode to perform shunt calibration.

  The other linear scaling modes are the same as those listed for voltage measurement.

  ▶ See here.

- **P1:X**

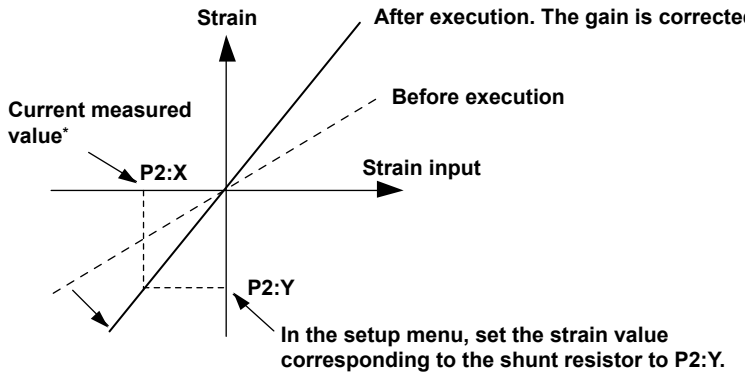
  When (Shunt Cal) Exec is performed, the input value when the relay circuit is off is applied.
- **P1:Y**

  Set the value for when the relay circuit is off (normally 0).
- **P2:X**

  When the relay circuit is on and (Shunt Cal) Exec is performed, the input value when the relay circuit is on is applied.
- **P2:Y**

  Set the strain value that corresponds to the shunt resistance when the relay circuit is on.

Shunt calibration



*** Obtained automatically when shunt calibration is performed**

Executing Shunt Calibration (Shunt Cal)

- **Exec**

  Executes shunt calibration.

Unit String (Unit String)

You can set the unit using up to four alphanumeric characters.

Display Type (Display Type)

The same as the linear scaling settings for voltage measurement.

▶ See here.

For details about shunt calibration, see appendix 4.

- When you execute shunt calibration, select an appropriate range so that the measured values will stay within the range when the shunt-calibration relay circuit is on. The DL850/DL850V attempts to perform shunt calibration within the current range.
- An error message will appear if shunt calibration fails (because of out-of-range values or some other reason). When this happens, change the range, and perform shunt calibration again.

Acceleration Measurement

For acceleration measurement, the items that have to be set for each input signal (CH1 to CH16) include vertical scales, the vertical positions, input coupling, the bias, the bandwidth limit, the zoom method, the gain, trace settings, sensitivity, and the unit.
The 701275 (ACCL/VOLT) acceleration module (with AAF) can measure acceleration by using the signal from an acceleration sensor. You can connect it directly to an acceleration sensor with a built-in amp.
Load-output-type acceleration sensors without amp circuits cannot be connected directly to the 701275 (ACCL/VOLT). For information about how to connect acceleration sensors, see section 3.11 in the *Getting Started Guide*, IM DL850-03EN.

Waveform Display (Display)

Select whether to display each channel's input signal waveform.

- ON: Displays the waveform
- OFF: Does not display the waveform

Labels (Label)

▶ See here.

Vertical Scale (SCALE knob)

▶ See here.

Waveform Vertical Position (Vertical POSITION knob)

▶ See here.

Input Coupling (Coupling)

To measure acceleration with the 701275 (ACCL/VOLT), set the input coupling to ACCEL.
To measure voltage, set the input coupling to an appropriate voltage measurement setting.

▶ See here.

Bias (Bias)

Select whether to supply bias current to the acceleration sensor.

- ON: Bias current is supplied to the acceleration sensor.
- OFF: Bias current is not supplied to the acceleration sensor.

- Do not connect an acceleration sensor when Bias is set to ON. Doing so may damage the DL850/DL850V.
- The bias current is 4 mA.

Bandwidth (Bandwidth)

You can set the bandwidth limit to 40 Hz, 400 Hz, 4 kHz, Auto, or Full.
When you set the bandwidth limit to Auto, an anti-aliasing filter (AAF) and low-pass filter are set in accordance with the sample rate, and high-frequency noise is removed from the input signal. By using an anti-aliasing filter when you measure voltages, you can remove the aliasing in the FFT.

▶ See here.

The filters can be used not just in acceleration measurements, but also in voltage measurements.

Zoom Method (V Scale), Zooming by Setting a Magnification (V Zoom), Zooming by Setting Upper and Lower Display Limits (Upper/Lower)

▶ See here.

Gain (Gain)

You can set the ratio of the output signal to the input signal to a value from 0.1 to 100.
The default setting is 1.

Trace Settings (Trace Setup)

▶ See here.

Sensitivity (Sensitivity)

You can set the sensitivity of the acceleration sensor that you are using to a value between 0.10 mV/Unit and 2000.00 mV/Unit.

Unit (Unit)

Set the unit of acceleration to be displayed using up to four characters. The default setting is m/s^2. Change the unit as necessary.
Up to eight unit character strings can be stored in memory. You can recall stored character strings by pressing the History soft key. Also, stored character strings can also be used by other acceleration modules on other channels. This feature is useful when you want to set multiple channels to the same unit. The stored character strings are not cleared when you turn the power off.

Frequency Measurement

For frequency measurement, the items that have to be set for each input signal (CH1 to CH16) include vertical scales, the vertical positions, FV settings, the input settings, the zoom method, the offset, trace settings, and linear scaling.

You can connect a sensor or probe to the 701280 (FREQ) frequency module and measure frequencies, revolutions, periods, duty ratios, power supply frequencies, pulse widths, pulse integration, and velocities. For the sensor connection method, see section 3.12 in the *Getting Started Guide*, IM DL850-03EN. For the probe connection method, see section 3.5.

- Waveform Display (Display)
- Labels (Label)
- Vertical Scale (SCALE knob)
- Waveform Vertical Position (Vertical POSITION knob)
- FV Settings (F/V Setup)
- Settings for Each Item
- Input Setup (Input Setup)
- Zoom Method (V Scale)
- Zooming by Setting a Magnification (V Zoom)
- Zooming by Setting Upper and Lower Display Limits (Upper/Lower)
- Offset (Offset)
- Trace Settings (Trace Setup)
- Linear Scaling (Linear Scale)

Waveform Display (Display)

Select whether to display each channel's input signal waveform.

- ON: Displays the waveform
- OFF: Does not display the waveform

Labels (Label)

▶ See here.

Vertical Scale (SCALE knob)

▶ See here.

Waveform Vertical Position (Vertical POSITION knob)

▶ See here.

FV Setting (F/V Setup) - frequency measurement

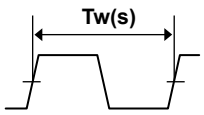
Measured Item (Function)

You can choose one of the following items to measure.

- **Frequency (Frequency)**

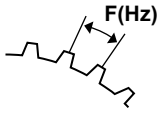
  Frequency (Hz) = 1 ÷ Tw (s)

  Measurable range: 0.01 Hz to 200 kHz



- **Revolutions (rpm)/Revolutions (rps) (Revolution(rpm)/Revolution(rps))**

  Revolutions (rpm) = Frequency (Hz) ÷ pulses per revolution (Nr) × 60
  Measurable range: 0.01 rpm to 100000 rpm
  Revolutions (rps) = Frequency (Hz) ÷ pulses per revolution (Nr)
  Measurable range: 0.001 rps to 2000 rps



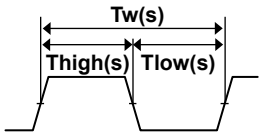
Number of pulses per rotation: Nr

- **Periods (Period)**

  Period (s) = Tw (s)
  Measurable range: 5 µs to 50 s

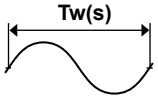
- **Duty Ratios (Duty)**

  Duty (%) = Thigh (s) ÷ Tw (s)
  Or, Duty (%) = Tlow (s) ÷ Tw (s)
  Measurable range: 0% to 100%



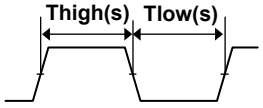
- **Power Supply Frequencies (Power Freq)**

  Power supply frequency (Hz) = 1 ÷ Tw (s)
  Resolution: 0.01 Hz
  Measurable range: (50 Hz, 60 Hz, or 400 Hz) ± 20 Hz



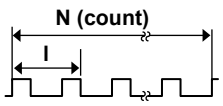
- **Pulse Widths (Pulse Width)**

  Pulse width (s) = Thigh (s)
  Or, pulse width (s) = Tlow (s)
  Measurable range: 2 µs to 50 s



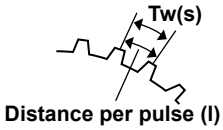
- **Pulse Integration (Pulse Integ)**

  Pulse integration = N (count) × physical amount per pulse (I)
  Set the physical amount per pulse (I) to the distance or flow rate.
  A suitable user-defined unit can be assigned to the specified physical amount.
  Measurable range: Up to 2×10^9 counts



- **Velocity (Velocity)**

  Velocity (km/h) = distance per pulse l (km) ÷ Tw (s) × 3600
  Velocity (m/s) = distance per pulse l (m) ÷ Tw (s)
  You can define unique distances and units (angular velocity and other units).
  Measurable range: F (= 1/Tw) = 0.01 Hz to 200 kHz



Settings for Each Item

When Measuring Revolutions

Pulse/Rotation Setting (Pulse/Rotate)

Set the number of pulses per revolution to a value from 1 to 99999.

When Measuring Duty Ratios or Pulse Widths

- **Measured Pulse Setting (Measure Pulse)**

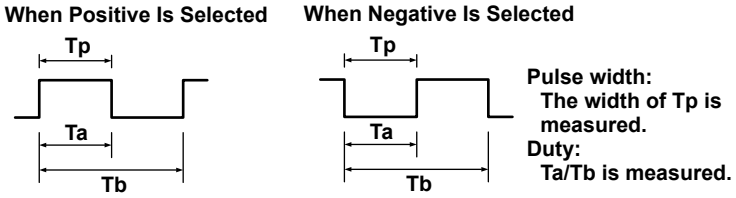
  Set the type of pulse to measure to Positive or Negative.

  When Measuring Duty Ratios

  - Positive: The rising-pulse percentage is measured.
  - Negative: The falling-pulse percentage is measured.

  When Measuring Pulse Widths

  - Positive: The rising-pulse width is measured.
  - Negative: The falling-pulse width is measured.

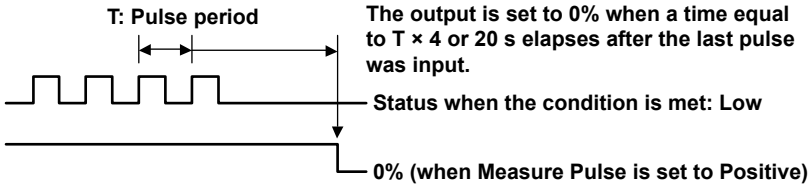


Notes about Duty Ratio Measurement

During duty ratio measurement, the output changes to 0% or 100% when one of the following conditions is met:

- A pulse is not received for a period of time equal to four times the period of the previous pulse (T).
- A pulse is not received for 20 seconds.

When Measure Pulse is set to Positive if one of the above conditions is met and the pulse input is low, the ratio is 0%; if the pulse input is high, the ratio is 100%. When Measure Pulse is set to Negative if one of the above conditions is met and the pulse input is high, the ratio is 0%; if the pulse input is low, the ratio is 100%.


T: Pulse period
The output is set to 0% when a time equal to T × 4 or 20 s elapses after the last pulse was input.
Status when the condition is met: Low
0% (when Measure Pulse is set to Positive)

When Measuring Power Supply Frequency

Center Frequency Setting (Center Frequency)

Set the center frequency to 50 Hz, 60 Hz, or 400 Hz.

When Measuring Pulse Integration

- **Unit/Pulse Setting (Unit/Pulse)**

  You can set the physical amount per pulse to a value from −9.9999E+30 to 9.9999E+30.

- **Unit Setting (Unit)**

  You can set the displayed pulse-integration unit as necessary using up to four characters.

- **Over Limit Reset Setting (Over Limit Reset)**

  Select ON to reset the pulse count when the range is exceeded. If you do not want to reset the pulse count, select OFF. The default setting is OFF.

- **Manual Reset (Reset)**

  To manually reset the pulse count, select Exec.

When Measuring Velocity

- **Distance/Pulse Setting (Distance/Pulse)**

  You can set the distance per pulse to a value from −9.9999E+30 to 9.9999E+30.

- **Time Unit Setting (Time Unit)**

  You can set the unit of time to hour, min, or sec.
  The output is automatically converted to the appropriate velocity for the specified time.

- **Unit Setting (Unit)**

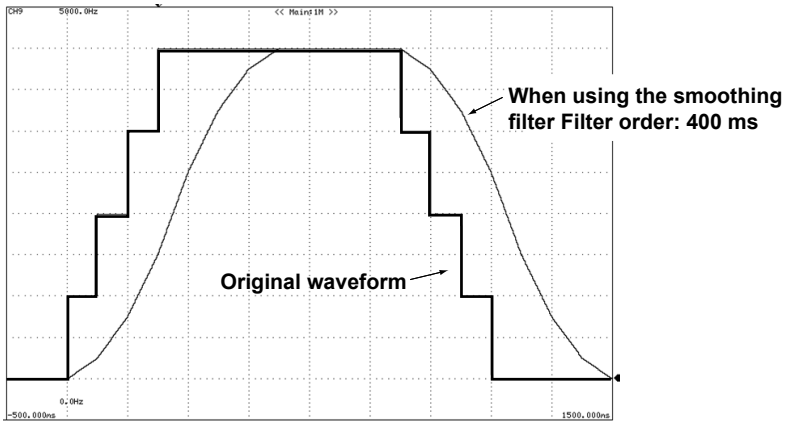
  Set the unit of velocity to be displayed using up to four characters. The default setting is m/s.

Filter (Filter)

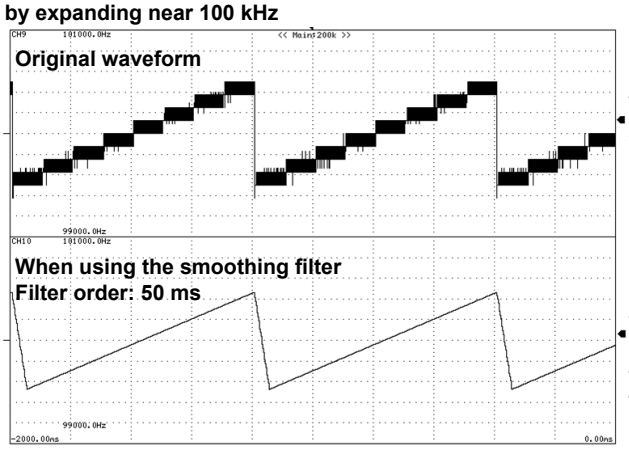
- **Smoothing (Smoothing)**

  The frequency module can display waveforms using real-time moving averages of the data. The moving average order can be set through the specification of a time value from 0.1 ms to 1 s (the maximum number of averages is 25000). The number of averages performed (moving average order) = the specified time ÷ 40 μs.

  The smoothing filter has the following characteristics.
  - Smoothes out staircase patterns.
  - Enables you to reduce measurement jitter and increase the resolution. Because of the increased resolution, you can perform high-precision measurements, especially when you measure high frequencies or use the offset feature and enlarge the waveform.
  - Can be used with all frequency-module measurement items.

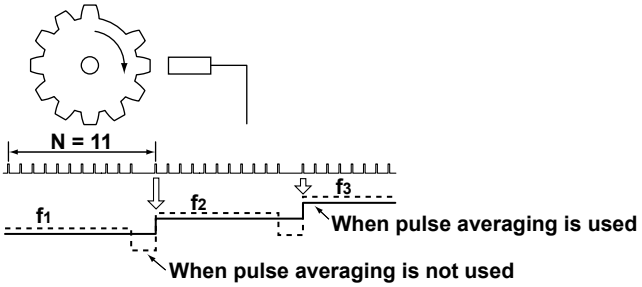


When using the offset function and making measurements by expanding near 100 kHz



- **Pulse Averaging (PulseAverage)**

  The input pulses are divided into groups of a specified number (1 to 4096 pulses) and measured. Pulse averaging has the following characteristics.
  - Enables you to eliminate the effects of missing pulses and inconsistent pulse intervals (inconsistencies in the frequency or period waveform) on measurement.
  - Even if you use pulse averaging, the measured results are displayed as per-pulse values, so there is no need to reperform scaling.
  - Pulse averaging can be used in measurements of frequencies, revolutions, periods, power supply frequencies, pulse integration, and velocities.



Deceleration and Stop Prediction

The 701280 (FREQ) automatically performs internal computation and displays waveforms by predicting the deceleration curve and stop point even when the input pulse is suddenly cut off. This function enables the measurement of waveforms of deceleration behavior that are close to the actual physical phenomenon in applications in which the deceleration behavior of an object that has inertia is measured, such as in automobile brake tests.

- **Deceleration Prediction (Deceleration Prediction)**

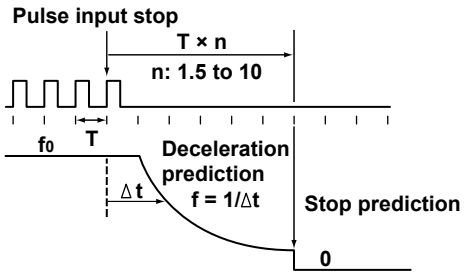
  The deceleration curve is computed according to the following equation using the elapsed time after the pulse input stops (Δt).

  Frequency (f) = 1/elapsed time (Δt)

  The deceleration prediction starts after the pulse input stops and a pulse period (T) of the pulse one period before the pulse input stopped elapses.

- **Stop Prediction (Stop Prediction)**

  The point at a specified time after the pulse input stops is considered a stop point, and the frequency is set to 0. The time from the point when the pulse input stops to the point when the DL850/DL850V determines that the object has stopped can be set to 1.5, 2, 3, ..., 9, or 10 times (10 options) the pulse period (T) of the pulse one period before the pulse input stopped.



Input Setup (Input Setup) - frequency measurement

Presets (Preset)

When you select a preset, the DL850/DL850V automatically configures appropriate settings for all the signals (for some preset options, there are some settings that you will need to configure). You can select User to set all the settings to user-defined values. There are 10 types of presets. For details about the settings of each preset, see appendix 6.

- **Logic 5V, Logic 3V, Logic 12V, Logic 24V**

  Use this preset when the output from the sensor or other equivalent item changes in the range of 0 V to 5 V (or 3 V, 12 V, or 24 V: supply voltage applied to the sensor). The voltage range is automatically set to the optimum voltage range, and the threshold level is automatically set to one-half the voltage.

- **Pull-up 5V**

  Use this preset when the sensor output is open collector or contact output. The pull-up function is enabled only when this preset is selected. The pull-up voltage is approximately 5 V, and the pull-up resistor is 4.7 kΩ. If you enable the pull-up function, set the input voltage to a value from 0 V to 5 V. If the input voltage exceeds this range, the protection circuit is tripped, and the pull-up resistor is automatically cut off.

- **Zero Cross (ZeroCross)**

  Use this preset when the input voltage changes around 0 V. The input coupling is automatically set to AC, and the threshold level is automatically set to 0 V. When you set the voltage range, make sure that the maximum amplitude does not exceed the voltage range.

- **AC100V, AC200V**

  Use this preset when measuring the supply voltage of 100 V or 200 V power supply systems. The probe type is automatically set to 10:1, the voltage range is automatically set to a value suitable for the input voltage and probe factor, and the coupling is automatically set to AC. Be sure to use the isolated probe (700929) when measuring the power supply voltage.

- **Electromagnetic Pickup (EM Pickup)**

  Use this preset when connecting an electromagnetic pickup directly. The voltage range is automatically set to ±1 V, and the threshold level is automatically set to 0 V.

- **User-Defined (User)**

  Use this preset to configure user-defined input conditions. The pull-up function cannot be enabled.

- When measuring high voltages exceeding 42 V (AC+DCpeak) on the 701280 (FREQ), be sure to use the isolated probe (700929).
- Use EM Pickup only when connecting an electromagnetic pickup.
- When the EM Pickup preset is selected, the LEDs of the frequency module do not illuminate in red, even when the range is exceeded.
- The DL850/DL850V does not support electromagnetic pickups that need to have power supplied to them or pickups that require terminators at the output. Handle these types of electromagnetic pickups using sensors.
- Keep the output of the electromagnetic pickup within 42 V_{P-P}. The minimum sensitivity is 0.2 V_{P-P}. If the output is less than the minimum sensitivity, the measured values may be unstable.
- When you use the pull-up function, do not let the voltage go outside the range of 0 to 5 V. If the voltage goes outside of this range, the protection circuit will be tripped, and the pull-up circuit will be cut off.

The following 9 setup items are available.

Voltage Range (V Range)

You can set the input voltage range (±FS) to one of the options below.

- When the probe attenuation (Probe) is set to 1:1
  ±1 V, ±2 V, ±5 V, ±10 V, ±20 V, ±50 V (±FS)
- When the probe attenuation (Probe) is set to 10:1
  ±10 V, ±20 V, ±50 V, ±100 V, ±200 V, ±500 V (±FS)

Input Coupling (Coupling)

You can set the input coupling to DC or AC.

▶ See here.

Probe Type (Probe)

You can set the probe type to 1:1 or 1:10.

▶ See here.

Bandwidth (Bandwidth)

You can set the bandwidth limit to 100 Hz, 1 kHz, 10 kHz, 100 kHz, or Full. You cannot select Full when Preset is set to AC100V or AC200V.

▶ See here.

Threshold Level (Threshold)

You can set the level within the FS of the input voltage range. The resolution is the value that corresponds to 1% of the FS.

Hysteresis (Hysteresis)

You can set the hysteresis to ±1%, ±2.5%, or ±5% of the FS of the input voltage range.

Slope (Slope)

Select ⨍ (rising) or ⨍ (falling).

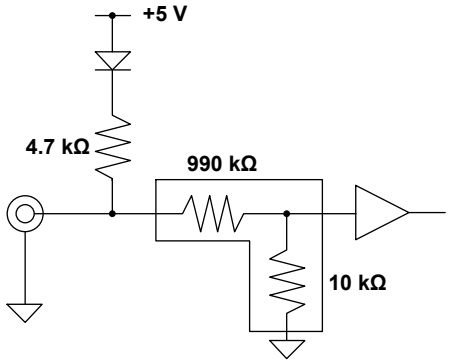
Chattering Elimination (Chatter Elimination)

Eliminates the chattering that occurs in cases such as when the contact input is turned on or off. The changes in the signal over the specified time can be discarded. You can set the interval to a value from 0 to 1000 ms (in 1 ms steps). When 0 ms is selected, chattering elimination is turned off.
Chattering elimination works on both rising and falling edges.

Pull Up (Pull Up)

You can only choose whether to enable the pull-up function when Preset is set to Pull-up 5V. You cannot configure the pull-up setting when another preset is selected.
If you enable the pull-up function, set the input voltage to a value from 0 V to 5 V. If you apply a voltage that is outside of this range, the internal protection circuit will cut off the pull-up circuit.

Internal Equivalent Circuit for When the Pull-up Function Is Enabled



Zoom Method (V Scale), Zooming by Setting a Magnification (V Zoom), Zooming by Setting Upper and Lower Display Limits (Upper/Lower)

▶ See here.

Offset (Offset)

▶ See here.

Trace Settings (Trace Setup)

▶ See here.

Linear Scaling (Linear Scale)

▶ See here.

Logic Measurement

For logic measurement, the items that have to be set for each input signal (CH1 to CH16) include vertical scales, the logic bit settings, the logic bit mapping, the zoom method, and trace settings.
You can measure logic signals by connecting a logic probe to the 720230 (LOGIC) logic module.
For information about how to connect logic probes, see section 3.10 in the *Getting Started Guide*, IM DL850-03EN.

Waveform Display (Display)

Select whether to display each channel's input signal waveform.

- ON: Displays the waveform
- OFF: Does not display the waveform

Labels (Label)

▶ See here.

Waveform Vertical Position (Vertical POSITION knob)

▶ See here.

Logic Bit Settings (Logic Bit Setup)

Bit Display (Display)

You can set whether to display the waveform of each bit.
Bit1 to Bit8, All Bits On, All Bits Off

Bit Name (Bit Name)

You can assign labels to bits using up to eight characters.

Chattering Elimination (Chatter Elimination)

For each bit, you can set whether to eliminate chattering. To eliminate chattering, select an elimination time.
OFF, 5msec, 10msec, 20msec, 50msec, 100msec

Bit Mapping (Bit Mapping)

- Fixed: Spaces are allocated for bits that are turned off.
- Auto: Spaces are not allocated for bits that are turned off. Only the bits that are turned on are displayed. The bits are displayed in order from the top.

Fixed (When bit 7 is off)

A1
A2
A3
A4
A5
A6
A8

Auto (When bit 7 is off)

A1
A2
A3
A4
A5
A6
A8

Zooming by Setting a Magnification (V Zoom)

▶ See here.

Trace Settings (Trace Setup)

▶ See here.

Note about Logic Measurement

In the logic settings in the preferences, you can set the display format (Bit or Hex), the cursor order, and the bit order.

▶ See here.

CAN Bus Signal Monitoring (Applies to the DL850V)

You can monitor CAN bus signals using the CAN bus monitor module (720240). CAN bus signal monitoring is only available on the DL850V.

The module can be connected as a node to an ISO-11898 CAN bus. The DL850V uses the module to read the data frames transferred on the CAN bus and then extracts the specified portion of the data field (CAN data), converts it to time series data, and displays its waveform. The module has two ports. Up to 16 sub channel waveforms can be displayed for each port. You can specify (define) the CAN data using Vector Informatik CANdb database files. Both the standard and extended formats are supported.

In addition, you can output single data frames or remote frames to a CAN bus at a specific time (one-shot output).

For CAN bus signal monitoring using a CAN bus monitor module, the items that have to be set include port settings, data extraction conditions, the sub channel display range, the unit of measurement, trace settings, and scaling.

- You can install up to two CAN bus monitor modules (CAN MONITOR). CAN bus monitor modules can only be installed in slots 7 and 8.
- The DL850V requires the following processing times to read data frames transferred on the CAN bus. New data frames that the DL850V receives during these processing times may be discarded.

Number of Channels Used per Port	One Port in Operation	Two Ports in Operation
1	40 µs	80 µs
8	60 µs	120 µs
16	80 µs	160 µs

Waveform Display (Display)

You can select whether to display each port's input signal waveforms. Each port corresponds to one of the CH13 to CH16 keys.

- ON: Displays the waveform
- OFF: Does not display the waveform

Reading Data Frames (Port Configuration)

Port Settings (Port Setup)

- **Bit Rate (Bit Rate)**

  Select the CAN bus signal transmission speed from one of the options below.
  10k, 20k, 33.3k, 50k, 62.5k, 83.3k, 125k, 250k, 500k, 800k, 1Mbps

- **Sample Point (Sample Point)**

  Select the sample point for each bit from one of the options below.
  71%, 78%, 85%

- **Resynchronization Jump Width (Sync Jump Width)**

  Set the correction value used to synchronize the bit timing between sending and receiving nodes.
  1 to 4 in units of Tq (Time Quantum)

- **Number of Samples (Bit Sample Num)**

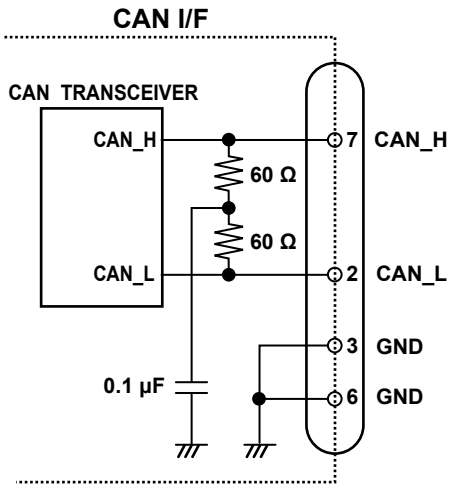
  You can set the number of samples at each bit's sample point.
  1: The sample point data is sampled once. We recommend that you use this setting for high-speed busses.
  3: The sample point data is sampled three times. We recommend that you use this setting for slow and medium speed busses.

- **Listen Only (Listen Only)**

  ON: The ACK bit is not transmitted.
  OFF: The ACK bit is transmitted.

- **Terminator (Terminator)**

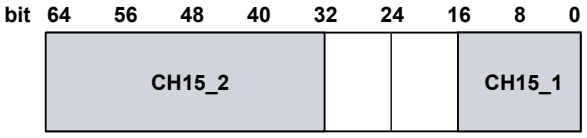
  ON: The 120 Ω terminator between CAN_H and CAN_L on the CAN bus line is turned on.
  OFF: The terminator between CAN_H and CAN_L on the CAN bus line is turned off.



CAN Data Extraction Conditions

You can use the extraction conditions to specify which portion of the CAN data in the data field to assign to each sub channel. For each port, you can configure up to 16 sub channels (up to 60 sub channels on modules whose firmware version is 1.2 or later).

When the data field contains two units of data



- Start Bit = 0, Bit Count = 16bit → 2-byte integer (CH15_1)
- Start Bit = 32, Bit Count = 32bit → 4-byte integer (CH15_2)
  4-byte real numbers can be extracted by modules whose firmware version is 1.2 or later.

- **Input (Input)**

  ON: The data is monitored.
  OFF: The data is not monitored or displayed.

- **Labels (Label)**

  You can specify a name of up to 16 characters in length for each channel.
  You can use the DISPLAY menu to set whether to display labels.
  ▶ See here.

- **Message Format**

  Set the message format of the collected data frames.
  STD: Standard format
  XTD: Extended format

- **ID**

  Set the message ID of the collected data frames.
  Standard format: 0 to 7FFH (11 bits)
  Extended format: 0 to 1FFFFFFFH (29 bits)

- **Byte Count**

  Set the byte count.
  Auto, 1 to 8

- **Start Bit**

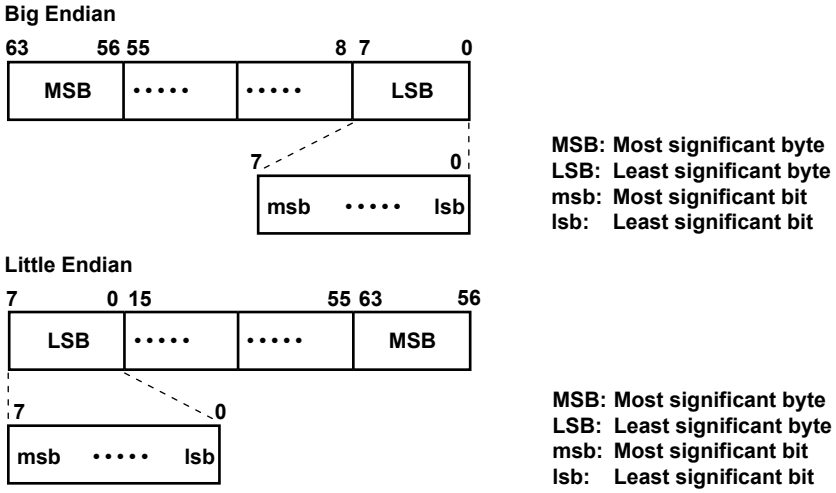
  Specify the bit number of the data extraction starting point.
  0 to 63

- **Bit Count**

  Specify the number of data bits to extract.
  2 to 16 (32 for firmware versions 1.2 and later)
  However, when the data type is set to Float, the only bit length that can be set is 32.

- **Byte Order**

  Select the method (endian) to use to store the data in the acquisition memory.



CAN Data Conversion Conditions

- **Value Type**

  Select the data type of the extracted CAN data.
  Unsigned: Unsigned integer
  Signed: Signed integer
  Float: Real number (applies to modules whose firmware version is 1.2 or later)
  Logic: Boolean

- **Factor/Offset**

  Configure these settings when the data type is set to Unsigned, Signed or Float. The DL850/DL850V uses the factor and offset values that you set here to convert extracted data to physical values
  Factor: Scaling coefficient (value per bit)
  Offset: Offset value
  Selectable range: −9.9999E+30 to +9.9999E+30

- **Unit**

  Using up to 16 characters, enter the unit to display for the waveform.

Loading a CAN Data Definition File (Setup File Read)

You can configure the CAN data extraction conditions by loading a CAN data definition file (an SBL file*).
Data that has been edited using Symbol Editor* is assigned to DL850V's sub channels 1 to 16 according to the order in the definition list (the order can be changed as you like on the Symbol Editor's definition list).

* An SBL file (.SBL extension) is a CANdb file (.dbc extension) that has been converted and edited into a physical value/symbol definition file using YOKOGAWA's free Symbol Editor software. You can obtain Symbol Editor from the YOKOGAWA website (http://www.yokogawa.com/tm/).
CANdb files (.dbc) are signal definition database files created using the CANdb or CANdb++ software produced by Vector Informatik.

Sub Channels 1 to 16 (Sub Channel 1 to 16)

(You can configure up to 60 sub channels on modules whose firmware version is 1.2 or later.)

Configure the display-label, scaling-method, and display-range settings of the specified sub channel.

Labels (Label)

▶ See here.

Scaling (Scale)

Auto: The upper and lower display range limits are set automatically.
Default: To the greatest extent possible within the settable range, the maximum and minimum values are used to set the display range setting (which is explained below) of the specified sub channel.

Display Range (Upper/Lower)

Specify the upper and lower limits of the waveform display range.
Selectable range: −30.000E+30 to +30.000E+30

One-Shot Output (One shot out)

A single specified data frame or remote frame is output at the specified time.

Message Format

Select the message format.
STD: Standard format
XTD: Extended format

ID

Set the message ID of the output data frame.
Standard format: 0 to 7FFH (11 bits)
Extended format: 0 to 1FFFFFFFH (29 bits)

DLC

Set the byte size of the data area of the data frame.
Selectable range: 1 to 8

Data(Hex)

In hexadecimal notation, specify the data frame value to output.

One shot out

Output the data.

You cannot output the data when in the Port Setup menu, Listen Only is set to ON.

Trace Settings (Trace Setup)

▶ See here.

Configuring the Scales of All Sub Channels (All SubChannel Scale)

Configure the scales of all sub channels.

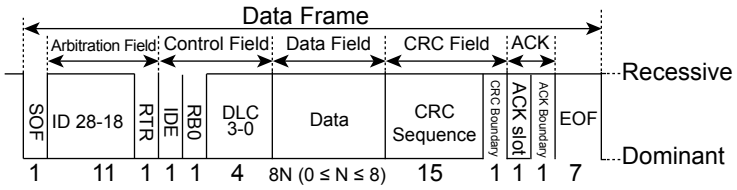
All SubChannel Auto: The upper and lower display range limits are set automatically.

All SubChannel Default: To the greatest extent possible within the settable range, the maximum and minimum values are used to set the upper and lower limits of all sub channels.

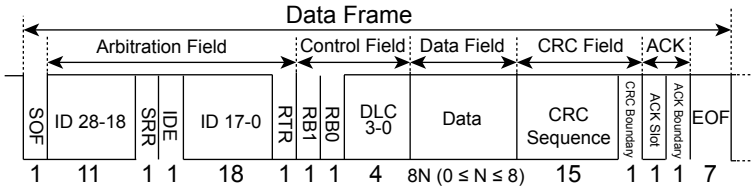
Frame Formats

Data Frames

- **Standard format**

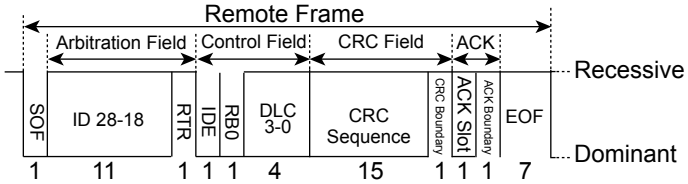


- **Extended format**

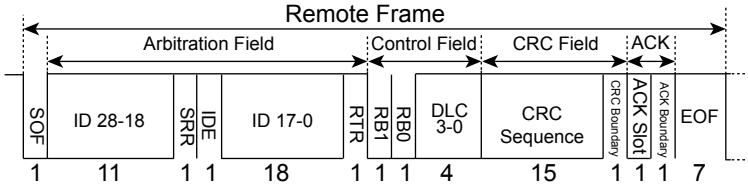


Remote Frames

- **Standard format**



- **Extended format**



Motorola's Forward format setting is not supported.

Displaying the Menu for Configuring All Channels (ALL CH)

Input Settings (Setup)

You can configure the settings of all channels while viewing the settings in a list. You can also set all the settings for a type of item at once and copy the various vertical axis settings of one channel to another channel. There are some items that cannot be configured from the ALL CH list.

Measurement Type	Settings
Voltage	Waveform display color, waveform display (Disp), label (Label), coupling (Coupling), vertical scale (V Scale), bandwidth limit (Band Width), zoom method (DIV/Scale), offset (Offset), position (Position), magnification for zooming (V Zoom), display range limits for zooming (Upper/Lower), probe attenuation and current-to-voltage conversion ratio (Probe)
Voltage (for the 16-CH Voltage Input Module)	Waveform display color, waveform display (Disp), label (Label), coupling (Coupling), vertical scale (V Scale), bandwidth limit (Band Width), zoom method (DIV/Scale), offset (Offset), position (Position), magnification for zooming (V Zoom), display range limits for zooming (Upper/Lower)
Temperature	Waveform display color, waveform display (Disp), label (Label), coupling (Coupling), thermocouple type (Type), bandwidth limit (Band Width), display range settings (Upper/Lower), reference junction compensation (RJC), burnout (Burn Out)
Strain	Waveform display color, waveform display (Disp), label (Label), range unit (Range Unit), measurement range (Range), bandwidth limit (Band Width), display range settings (Upper/Lower), gauge factor (Gauge Factor), bridge voltage (Excitation)
Acceleration	Waveform display color, waveform display (Disp), label (Label), coupling (Coupling), gain (Gain), bandwidth limit (Band Width), zoom method (DIV/Scale), position (Position), magnification for zooming (V Zoom), display range limits for zooming (Upper/Lower), sensitivity (Sensitivity)
Frequency	Waveform display color, waveform display (Disp), label (Label), measured item (Function), vertical scale (V Scale), zoom method (DIV/Scale), offset (Offset), position (Position), magnification for zooming (V Zoom), display range limits for zooming (Upper/Lower), center frequency (CenterFreq), input settings (Input)
Logic	Waveform display color, waveform display (Disp), label (Label), bit display (Bit Display), chattering elimination (Chatter Elim.), position (Position), magnification for zooming (V Zoom), bit mapping (Mapping)

* In the menu for configuring all channels, for channels that correspond to CAN bus monitor modules, you can only set the Display setting, which determines whether waveforms are displayed.

Linear Scaling (Linear Scale)

You can configure the linear scaling settings of all channels while viewing the settings in a list. The settings that you can view and configure are listed below. This function is the same as the linear scaling function for voltage measurement.

Linear scaling (Linear Scale); A and B for AX+B or P1:X, P1:Y, P2:X, and P2:Y for P1-P2; unit string (Unit); display mode (Disp Type); number of decimal places (Decim Num); unit prefix (Sub Unit)

▶ See here.

The 701271 (STRAIN_DSUB) strain module supports shunt calibration.

Copy (Copy to)

You can copy the various vertical axis and linear scaling settings from one channel to other channels whose modules are of the same type as the source channel.

Source Channel (Source Channel)

Set the source channel to a channel from CH1 to CH16 or to 16chVOLT.*

* If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.

Destination Channels (Destination Channel)

You can set the destination channels by selecting ALL ON, ALL OFF, and CH1 to CH16.

Execute (Execute)

Select Execute to copy the settings.

- When the 16-CH Voltage Input Module is installed, you can also copy the settings of the sub channels. You can only specify channels as copy destinations.
- The waveform display color and label settings are not copied.

Strain Balance (Strain Balance)

You can perform strain balancing on multiple installed strain modules.

CH1 to CH16

Select the modules that you want to perform strain balancing on.

Balance (Balance): Execute (Execute)

Select to perform strain balancing.

For information about strain balancing, see the section on strain measurement.

▶ See here.

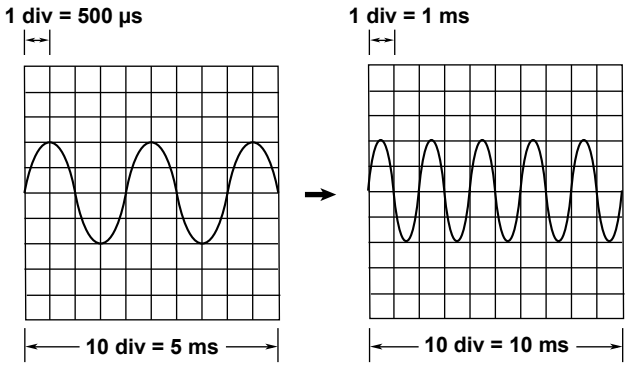
You cannot select channels in which strain modules are not installed.

3 Horizontal Axis

Time Axis Setting (TIME/DIV)

When the internal clock is being used, the time axis scale is set as a length of time per grid division (1 div). The time axis scale can be set within the following ranges: 100 ns/div* to 30 s/div, 1 min/div to 30 min/div, 1 hour/div to 12 hour/div, and 1 day/div to 3 day/div. The transition from seconds to minutes to hours to days occurs automatically. Because the horizontal display range is 10 div, the amount of time on the waveform that is displayed is equal to the time axis setting × 10.

* When the 720210 (HS100M12) module is installed, the scale range starts at 100 ns/div; when it is not installed, the scale range starts at 1 µs/div.



Internal and External Clocks (Time base selection)

Under the initial settings, the DL850/DL850V samples the waveform data using the clock signal produced by its internal time-base circuit (internal clock).

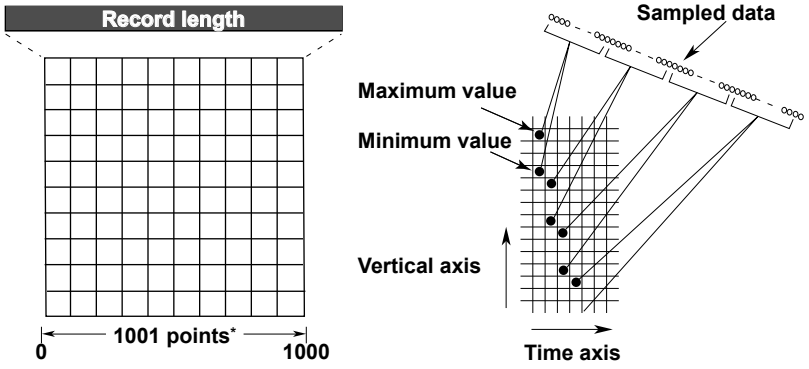
You can also use an external clock signal to control sampling. Apply the external clock signal to the external-clock input terminal on the left panel of the DL850/DL850V. This external clock input is useful for synchronizing to the clock signal of the waveform that is being measured.

When you control sampling using an external clock, you cannot change the time axis setting. To change the time-axis display range, change the record length or zoom in on the time axis.

▶ See here.

How the Time Axis Relates to the Display of the Waveform

There are 10 div along the time axis, and 1001 points (logical number of points, not the dots on the screen) are used to draw the waveforms. Therefore, if the display record length is exactly 1 kpoint (the number of acquired data points is 1001), the waveform is displayed using 1001 points. However, if the display record length is greater than or equal to 2 kpoint, as shown in the figure on the right, the DL850/DL850V draws the waveform by determining the maximum and minimum values at each fixed interval (P-P compression) and aligning them vertically at the same time position (total number of points: 2002).



*** 1001 is the logical number of points. On the screen, the data is compressed to 800 or 500 dots (1000 dots in the full-screen waveform display).**

<P-P compression display>

Zooming Horizontally and Drawing Waveforms

The DL850/DL850V can expand (zoom) the waveform horizontally. When the zoom factor of the waveform is increased, the number of displayed points decreases. The DL850/DL850V displays the waveform using P-P compressed until the number of displayed points falls to 2002, but it cannot display the waveform using continuous lines when the number of displayed points falls below 1001. When this happens, the DL850/DL850V interpolates the display data so that the number of displayed points is 1001.

Dot Display

Under the initial settings, display interpolation is performed automatically, but you can also disable display interpolation (set it to OFF) and display the waveform using dots. When interpolation is disabled, up to 2002 points or 100100 points (whichever is selected) of all the acquired data are displayed without P-P compression. For example, if the number of displayed points is set to 100 kpoint and the display record length is 10 kpoint (the number of acquired data points is 10010 points), the DL850/DL850V draws all the points of the waveform by aligning 10 points vertically at the same time axis position. If the number of acquired data points exceeds 2002 or 100100, to display the waveform, the DL850/DL850V reduces the amount of data to 2002 or 100100 points (whichever is selected) by removing the data between displayed points.

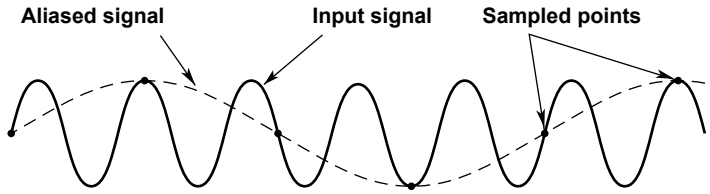
Relationship between the Time Axis Setting, Record Length, and Sample Rate

If you change the time axis setting, the sample rate and the acquisition-memory record length also change. For details, see appendix 1, “Relationship between the Time Axis Setting, Record Length, and Sample Rate” in the *Getting Started Guide*, IM DL850-03EN.

Sample Rate

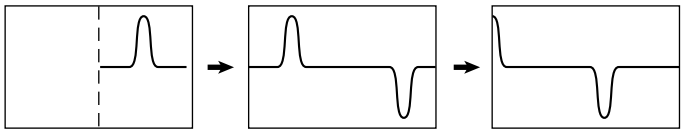
If you change the time axis setting, the sample rate also changes. The sample rate is the number of samples-per-second (S/s).

* If the sample rate is comparatively low with respect to the input signal frequency, the harmonics contained in the signal are lost. When this happens, some of the harmonics will be misread as low-frequency waves due to the effects described by the Nyquist sampling theorem. This phenomenon is called aliasing. You can avoid aliasing by acquiring waveforms with the acquisition mode set to Envelope.



Time Axis Setting and Roll Mode Display

When the trigger mode is Auto, Auto Level, Single, or On Start and the time axis setting is 100 ms/div or longer, instead of updating waveforms through triggering (update mode), the DL850/DL850V displays the waveforms in roll mode. In roll mode, waveforms scroll from right to left as new data is captured and the oldest values are deleted from the screen.



This allows waveforms to be observed in the same way as on a pen recorder. Roll mode is useful for observing signals with long repeating periods and signals that change slowly. It is also effective when you want to detect occasional glitches (pulse signals in the waveform).

You can use auto setup to automatically configure the appropriate settings (such as vertical axis, horizontal axis, and trigger settings) for the input signal. This feature is useful when you are not sure what type of signal will be applied to the DL850/DL850V. The auto setup feature will not work properly on some input signals. Also, there are some modules with which the auto setup feature cannot be used.

▶ See here.

Notes about Using the 16-CH Voltage Input Module

▶ See here.

4 Triggering

A trigger is a cue used to display the waveform on the screen. A trigger occurs when the specified trigger condition is met, and a waveform is displayed on the screen.

Trigger Mode (MODE)

The trigger mode determines the conditions for updating the displayed waveforms. There are six trigger modes.

Auto Mode (Auto)

If the trigger conditions are met before an approximately 50 ms timeout, the DL850/DL850V updates the displayed waveforms on each trigger occurrence. If not, the DL850/DL850V automatically updates the displayed waveforms. Even when Auto mode is specified, the DL850/DL850V operates in Normal mode when the trigger source is set to Time and a simple trigger is used.
If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled.

Auto Level Mode (AutoLevel)

If a trigger occurs before a timeout (which is approximately 1 second), the DL850/DL850V updates the waveform in the same way that it does in Auto mode. If a trigger does not occur, the DL850/DL850V detects the center value of the trigger source amplitude, automatically changes the trigger level to the center value, triggers on that value, and updates the displayed waveform. Auto-level mode is only valid if the trigger source is an analog waveform on a channel between CH1 and CH16 (including sub channels). For all other cases, Auto Level mode operates in the same way as Auto mode.
If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled.

Normal Mode (Normal)

The DL850/DL850V only updates the waveform display when the trigger conditions are met. If no triggers occur, the display is not updated. If you want to view waveforms that the DL850/DL850V cannot trigger on, or if you want to check the ground level, use Auto mode.

Single Mode (Single)

When the trigger conditions are met, the DL850/DL850V updates the displayed waveform once and stops waveform acquisition.
If the time axis is set to a range that causes the display to switch to roll mode, the roll mode display will be enabled. When the DL850/DL850V triggers, it begins recording data. When data has been acquired up to the amount specified by the set record length, the waveform display stops.

N Single Mode (SingleN)

The DL850/DL850V acquires waveforms each time the trigger conditions are met until a specified number of waveforms have been acquired, and then displays all the acquired waveforms. If no triggers occur, the display is not updated.

Instant Start Mode (On Start)

Regardless of the trigger settings, when you press the START key, the DL850/DL850V updates the displayed waveforms once and stops signal acquisition.
If the time axis is set to a value that would cause the display to switch to roll mode, roll mode display will be enabled. When data has been acquired up to the amount specified by the set record length, the waveform display stops.

- The trigger mode setting applies to all trigger types.
- When waveforms are being acquired, the trigger condition appears in the center of the bottom of the screen.

Trigger Types (Type)

The following trigger types are available.

Simple (Simple)

- Simple trigger: Simply triggers on a trigger source edge.
  In addition to using the signals (analog signals and logic signals) applied to the modules installed in the slots as trigger sources, you can also use the time, an external signal (the signal applied to the TRIG IN terminal), or the power line signal as a trigger source.

Enhanced (Enhanced)

- A -> B(N) trigger: After state condition A is met, the DL850/DL850V triggers when the state condition B is met N times.
- A Delay B trigger: After state condition A is met and the specified amount of time elapses, the DL850/DL850V triggers when the state condition B is first met.
- Edge On A trigger: While state condition A is met, the DL850/DL850V triggers on the OR of multiple trigger source edges.
- OR trigger: The DL850/DL850V triggers on the OR of multiple trigger source edges.
- AND trigger: The DL850/DL850V triggers on the AND of multiple trigger source conditions.
- Period trigger: The DL850/DL850V triggers on a specified period of occurrence of state condition B.
- Pulse Width trigger: The DL850/DL850V triggers after state condition B has been met for a specified duration (width).
- Wave Window trigger: The DL850/DL850V creates real-time templates (Wave Window) using a number of cycles directly preceding the current waveforms. The DL850/DL850V compares the current waveforms to the real-time templates and triggers if one of the current waveforms falls outside of its real-time template.

* A state condition is a condition that is met when the levels of specified trigger sources are High or Low relative to a specified trigger level. If you set a signal to X (Don't Care), the state of the specified signal is not used to determine whether the state condition is met.

Manual Trigger (Manual Trigger)

Regardless of the trigger settings, you can make the DL850/DL850V trigger by pressing the MANUAL TRIG key on the front panel.

Signal Type and Trigger Type Combinations

The signal type (analog or logic) determines what trigger types you can use.

	CH1 to CH16		
	Analog Signal (including sub channels)	Logic Signal Bit 1 to Bit 8	Mixed
Simple	Yes	Yes	–
A -> B(N)	Yes	Yes	Yes
A Delay B	Yes	Yes	Yes
Edge On A	Yes	Yes	Yes
OR	Yes	Yes	Yes
AND	Yes	Yes	Yes
Period	Yes	Yes	Yes
Pulse Width	Yes	Yes	Yes

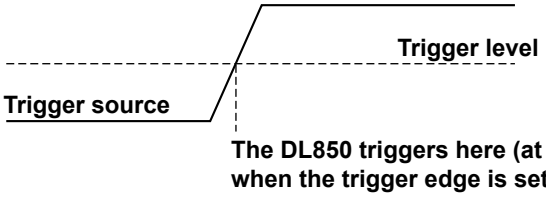
About the Wave Window Trigger ▶ See here.

Basic Trigger Settings

- Trigger source: The trigger source signal.
- Trigger slope: Specifies which edge, rising or falling, the DL850/DL850V will trigger on.
- Trigger level: The trigger determination level.
- Trigger hysteresis: The trigger level margin (the DL850/DL850V does not trigger on changes in the signal level within this margin).
- Trigger hold-off: The amount of time to wait before the next trigger detection (applies to all triggers except for the simple trigger when the trigger source is Time, the period trigger, and the manual trigger).
- Trigger position: The position where the trigger point will be displayed (applies to all trigger types).
- Trigger delay: The delay from the trigger point (applies to all trigger types).

Simple Trigger (Simple)

The DL850/DL850V triggers on trigger source edges (rising or falling edges). *Edge* refers to a point where the trigger source passes through the trigger level.



Trigger Source (Source)

The trigger source is the signal that is used to check for the trigger condition. You can set the source waveform to one of the waveforms below.

Analog Signal (CH1 to CH16)

Select a channel from CH1 to CH16 to use the analog signal being applied to the corresponding terminal as the trigger source.

CH1 to CH16,[1] 16chVOLT,[2] CAN[3]

1 You can select the channel of an installed module.

2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.

3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. However, you cannot select a sub channel whose Input setting is set to OFF. ▶ See here.

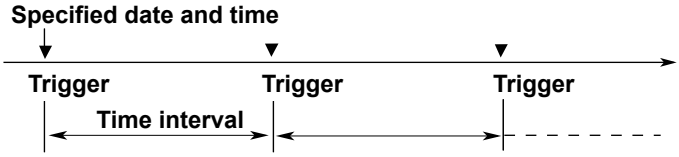
Logic Signal (Bit 1 to Bit 8)

Select a bit from 1 to 8 to use the logic signal being applied to the port of a logic input module as the trigger source. When a logic input module is installed in a slot, bits 1 to 8 appear as options below the channel that corresponds to that slot (CH1 to CH16).

Time (Time)

Select Time to use the date and time as the trigger source. The trigger occurs at the specified date and time and at specified intervals afterwards.

- Specify the year, month, day, hour, minute, and second.
- You can select one of the time intervals listed below.
  10sec, 15sec, 20sec, 30sec, 40sec, 50sec, 1min, 2min, 3min, 4min, 5min, 6min, 7min, 8min, 9min, 10min, 15min, 20min, 25min, 30min, 40min, 45min, 50min, 1hour, 2hour, 3hour, 4hour, 5hour, 6hour, 7hour, 8hour, 9hour, 10hour, 11hour, 12hour, 18hour, 24hour



- Depending on the specified time interval, a trigger may occur while the waveform is being acquired or in the pre-trigger section (the section before the trigger that is acquired for observation). When this happens, the trigger is ignored.
- If the specified date and time fall within the pre-trigger section, a trigger occurs at the end of the pre-trigger section.
- If the specified date and time are in the past, triggers occur at the points in the present defined by the function (specified date and time) + (time interval × integer N).
- If you set the number of acquisitions, the specified number of waveforms are acquired. When the specified number of acquisitions is infinite, waveform acquisition continues until you press START/STOP.

External Signal (External)
Select External to use the signal that is received through the left-panel TRIG IN input terminal as the trigger source.

Power Line Signal (Line)
Select Line to use the power line signal received by the DL850/DL850V as the trigger source. The DL850/DL850V only triggers on the rising edge. This option enables you to observe waveforms in synchronization with the power supply frequency (50 Hz or 60 Hz).

Trigger Level (Level)

Trigger level refers to the signal level used as a reference for detecting a signal's rising and falling edges or high and low states. With simple triggers such as the edge trigger, the DL850/DL850V triggers when the trigger source level passes through the specified trigger level.
The range and resolutions that you can use to set the trigger level vary depending on the type of signal being measured.

When Measuring Voltage
Selectable range: ±10 div (two times the display range)
Resolution: 0.01 div. (Example: when the probe attenuation is 1:1 and the voltage scale is 2 mV/div, the resolution is 0.02 mV.)

When Measuring Temperature
Selectable range: The range of thermocouple being used
Resolution: 0.1°C or 0.1 K

When Measuring Strain
Selectable range: The range of the strain module being used
Resolution: 1 µSTR or 0.0005 mV/V

When Measuring Acceleration
Selectable range: ±10.00 div
Resolution: 0.01 unit

When Measuring Frequency (Revolutions, periods, duty ratios, power supply frequencies, pulse widths, pulse integration, velocities,

When Monitoring CAN Bus Signals
See section 6.13 in the getting started guide, IM DL850-03EN.

You can normally set the trigger level using the jog shuttle and arrow keys. If you press the NUM LOCK key so that it illuminates, you can also enter numbers by pressing the CH key.

Trigger Slope (Slope)

Slope refers to the movement of the signal from a low level to a high level (rising edge) or from a high level to a low level (falling edge). When a slope is used as one of the trigger conditions, it is called a trigger slope.
The following trigger slope settings are available for triggering the DL850/DL850V.

↑	The DL850/DL850V triggers when the trigger source changes from a level below the trigger level to a level above the trigger level (rising).
↓	The DL850/DL850V triggers when the trigger source changes from a level above the trigger level to a level below the trigger level (falling).
↕	The DL850/DL850V triggers on both rising and falling edges.

* ↕ can only be selected when a simple trigger is used with an analog trigger source.

Trigger Hysteresis (Hysteresis)

Noise rejection establishes a trigger level margin (hysteresis) so that the DL850/DL850V does not trigger if the signal level change is within the margin.

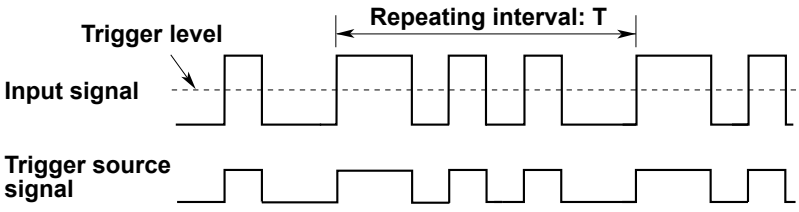
For each type of measured signal, you can set the hysteresis around the trigger level to one of the options listed below. You cannot set hysteresis when the trigger source is set to Time, External, Line, or a logic signal.

Voltage	Approx. ±0.1 div	Approx. ±0.5 div	Approx. ±1 div
Temperature	Approx. ±0.5°C (K)	Approx. ±1°C (K)	Approx. ±2°C (K)
Strain	Approx. ±2.5% of the range	Approx. ±12.5% of the range	Approx. ±25% of the range
Acceleration	Approx. ±0.1 div of the range	Approx. ±0.5 div of the range	Approx. ±1 div of the range
Frequency module	Approx. ±0.01 div of the range	Approx. ±0.5 div of the range	Approx. ±1 div of the range

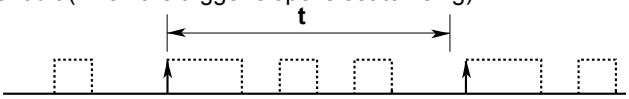
* The above values are approximate values. They are not strictly warranted.

Trigger Hold-Off (Hold Off)

The trigger hold-off feature temporarily stops the detection of the next trigger once a trigger has occurred. This feature is useful in cases when you want to change the waveform acquisition interval, such as when you are observing a PCM (pulse code modulation) code or other pulse train signal or when you are using the history feature.



Trigger signals that have been suppressed over the hold-off period t (when the trigger slope is set to rising)



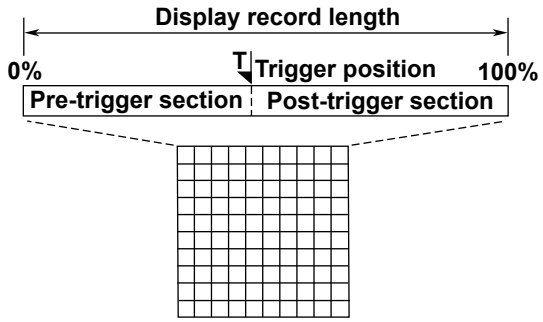
Selectable range: 0.00 µs to 10000000.00 µs (10 s). The default settings is 0.00 µs

Resolution: 0.01 µs

- To trigger with the hold-off time set to 50 ms or longer, set the trigger mode to Normal.
- For the A -> B(N) and A Delay B triggers, the hold-off time only applies to state condition B.
- The trigger hold-off time does not apply to the simple trigger when the trigger source is Time, to the period trigger, or to the manual trigger.

Trigger Position (Position)

When you move the trigger position, the ratio of the displayed data before the trigger point (the pre-trigger section) to the data after the trigger point (the post-trigger point) changes. When the trigger delay is 0 s, the trigger point and trigger positions coincide.



Selectable range: 0.0 to 100% of the display record length.
Resolution: 0.1%

- When waveform acquisition is stopped, if you change the trigger position, the setting is not applied until you start waveform acquisition and update the waveforms.
- If you change the time axis setting (using the TIME/DIV knob), the location of the trigger position does not change.

Time Reference Point

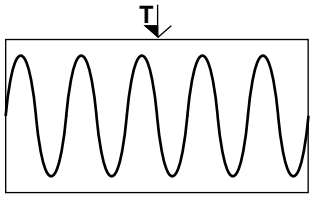
In addition to the trigger position, a time reference point is indicated. The times that appear in the lower left and right of the screen are the times from this time reference point. The cursor time-measurement values are also based on this reference point.
When waveform acquisition is stopped the displayed location of the time reference point varies as indicated below.

- **In Update Mode**

  When the displayed waveform is updated by the trigger, the time reference point is displayed as indicated below. The time reference point and the trigger point are the same.

  - Under Normal Waveform Update Conditions When All Pre-Trigger and Post-Trigger Data Has Been Acquired

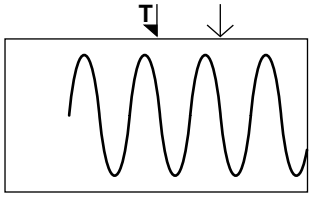
    The trigger position and the time reference point are displayed at the same position.



  - When Waveform Acquisition Is Stopped before All Pre-Trigger and Post-Trigger Data Has Been Acquired

    The trigger position and the time reference point are displayed separately.

    Trigger position Time reference point



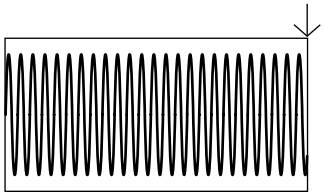
- **In Roll Mode**

  In roll mode, in which waveforms scroll from right to left, the time reference point is displayed as indicated below.

  - When the Trigger Mode Is Auto Mode or Auto Level Mode

    The point in time when waveform acquisition was stopped is the time reference point (right side of the screen).

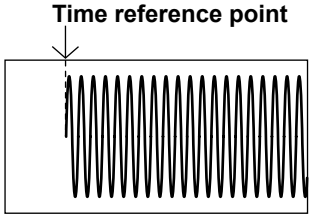
    Time reference point

  - When the Trigger Mode Is Instant Start Mode (On Start)

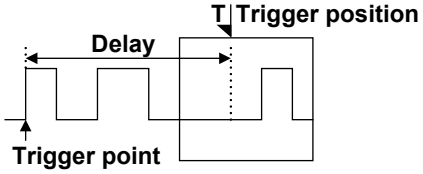
    The point in time when waveform acquisition was started is the time reference point.

    Time reference point

Trigger Delay (Delay)

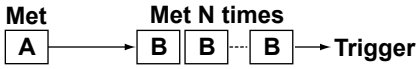
The DL850/DL850V normally displays waveforms before and after the trigger point. You can set a trigger delay to display waveforms that the DL850/DL850V has acquired a specified amount of time after the trigger occurrence.
Selectable range: 0.00 µs to 10000000.00 µs (10 s). The default settings is 0.00 µs
Resolution: 0.01 µs



- If you change the time axis setting (using the TIME/DIV knob) so that the unit becomes larger, because of display-digit limitations, the delay time that you set when the unit was small will not appear in the setting menu, but it is retained.
- You cannot specify a trigger delay when an external clock is being used as the time base.

A -> B(N) Trigger (Enhanced)

After state condition A is met, the DL850/DL850V triggers when state condition B is met N times.



Trigger Source

You can use CH1 to CH16 and Bit 1 to Bit 8 as the trigger sources. Bit 1 to Bit 8 appear as options when a logic input module is installed in a slot.

▶ See here.

State Conditions (A State, B State)

To set state conditions A and B, select the states of the trigger sources in relation to the trigger level.

Example

	State Condition A	State Condition B
CH1	H	H
CH2	L	L
CH3-		
Bit 1	L	H
Bit 2	H	X
……	…	…
Bit 8	X	L
CH4	X	X
……	…	…
CH16	X	H

H: The signal level must be high.
L: The signal level must be low.
X: The signal is not used as a condition.

State Condition Achievement Condition (A Condition, B Condition)

Select how the result of comparing the trigger source states to their specified conditions must change for a state condition to be considered met.

Enter	The result must change from not being met to being met.
Exit	The result must change from being met to not being met

Number of Times State Condition B Must Be Met

Set the number of times that state condition B must be met.
Selectable range: 1 to 10000. The default setting is 1.

Trigger Level (Level) and Trigger Hysteresis (Hys)

Set these items for each trigger source.
These items are the same as the trigger level ▶ See here. and hysteresis ▶ See here. of the simple trigger.

Trigger Hold-Off (Hold Off), Trigger Position (Position), Trigger Delay (Delay)

These items are the same as trigger hold-off ▶ See here., trigger position ▶ See here., and trigger delay ▶ See here. of the simple trigger.

A Delay B Trigger (Enhanced)

After state condition A is met and the specified amount of time elapses, the DL850/DL850V triggers when state condition B is first met.

Trigger Source

You can use CH1 to CH16 and Bit 1 to Bit 8 as the trigger sources. Bit 1 to Bit 8 appear as options when a logic input module is installed in a slot.

▶ See here.

State Conditions (A State, B State)

To set state conditions A and B, select the states of the trigger sources in relation to the trigger level.

Example

	State Condition A	State Condition B
CH1	H	H
CH2	L	L
CH3-		
Bit 1	L	H
Bit 2	H	X
……	…	…
Bit 8	X	L
CH4	X	X
……	…	…
CH16	X	H

H: The signal level must be high.
L: The signal level must be low.
X: The signal is not used as a condition.

State Condition Achievement Condition (A Condition, B Condition)

Select how the result of comparing the trigger source states to their specified conditions must change for a state condition to be considered met.

Enter	The result must change from not being met to being met.
Exit	The result must change from being met to not being met

Delay Time

Set the amount of time that must pass after state condition A is met.
Selectable range: 0.0 µs to 10000000.0 µs (10 s). The default settings is 0.0 µs.
Resolution: 0.1 µs

Trigger Level (Level) and Trigger Hysteresis (Hys)

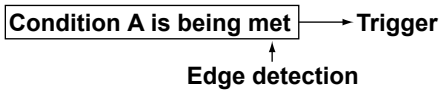
Set these items for each trigger source.
These items are the same as the trigger level ▶ See here. and hysteresis ▶ See here. of the simple trigger.

Trigger Hold-Off (Hold Off), Trigger Position (Position), Trigger Delay (Delay)

These items are the same as trigger hold-off ▶ See here., trigger position ▶ See here., and trigger delay ▶ See here. of the simple trigger.

Edge On A Trigger (Enhanced)

While state condition A is met, the DL850/DL850V triggers on the OR of multiple trigger source edges.



Trigger Source

You can use CH1 to CH16 and Bit 1 to Bit 8 as the trigger sources. Bit 1 to Bit 8 appear as options when a logic input module is installed in a slot.

▶ See here.

State Condition (A State)

To set state condition A, select the states of the trigger sources in relation to the trigger level.

Example

	State Condition A
CH1	H
CH2	L
CH3-	
Bit 1	L
Bit 2	H
……	…
Bit 8	X
CH4	X
……	…
CH16	X

H: The signal level must be high.
L: The signal level must be low.
X: The signal is not used as a condition.

State Condition Achievement Condition (Condition)

Select whether the result of comparing the trigger source states to their specified conditions must be true or false for the state condition to be considered met.

True	The result must be true.
False	The result must be false.

Edge Detection Condition (Edge)

Set the condition for detecting the trigger source edge.

⎍	An edge is detected when the trigger source changes from a level below the trigger level to a level above the trigger level (rising).
⎎	An edge is detected when the trigger source changes from a level above the trigger level to a level below the trigger level (falling).
–	The signal is not used as a trigger condition.

Trigger Level (Level) and Trigger Hysteresis (Hys)

Set these items for each trigger source.

These items are the same as the trigger level ▶ See here. and hysteresis ▶ See here. of the simple trigger.

Trigger Hold-Off (Hold Off), Trigger Position (Position), Trigger Delay (Delay)

These items are the same as trigger hold-off ▶ See here., trigger position ▶ See here., and trigger delay ▶ See here. of the simple trigger.

OR Trigger (Enhanced)

The DL850/DL850V triggers on the OR of multiple trigger source edges.

Trigger Source

You can use CH1 to CH16 and Bit 1 to Bit 8 as the trigger sources. Bit 1 to Bit 8 appear as options when a logic input module is installed in a slot.

▶ See here.

Edge Detection Condition (Edge)

Set the conditions for detecting each trigger source edge.

⤴	An edge is detected when the trigger source changes from a level below the trigger level to a level above the trigger level (rising).
⤵	An edge is detected when the trigger source changes from a level above the trigger level to a level below the trigger level (falling).
IN	An edge is detected when the trigger source enters the specified level range.
OUT	An edge is detected when the trigger source leaves the specified level range.
–	The signal is not used as a trigger condition.

* IN and OUT are only selectable when the trigger source is an analog signal (CH1 to CH16).

Trigger Level (Level)

Set these items for each trigger source.

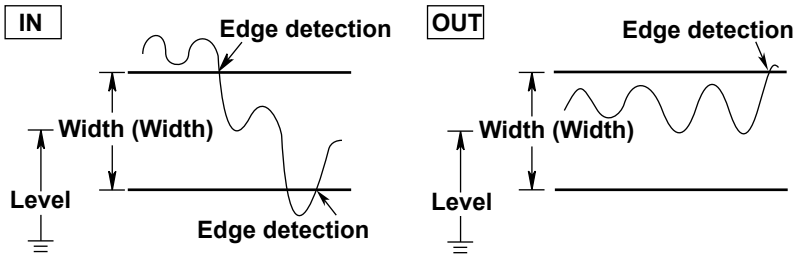
When the Edge Detection Condition Is ⤴ or ⤵

Set the level used to detect the trigger source's rising or falling edge.

▶ See here.

When the Edge Detection Condition Is IN or OUT

An edge is detected when the trigger source enters (IN) or leaves (OUT) the specified level range. You can specify the level range settings for each analog signal trigger source.



Setting	Selectable Range	Resolution
Level (center value) Width (Width)	Same as the trigger level	

Trigger Hysteresis (Hys)

Set this item for each trigger source.

This item is the same as the hysteresis ▶ See here. of the simple trigger.

Trigger Hold-Off (Hold Off), Trigger Position (Position), Trigger Delay (Delay)

These items are the same as trigger hold-off ▶ See here., trigger position ▶ See here., and trigger delay ▶ See here. of the simple trigger.

AND Trigger (Enhanced)

The DL850/DL850V triggers on the AND of multiple trigger source conditions. The DL850/DL850V triggers when all the specified conditions are met at a single point.

Trigger Source

You can use CH1 to CH16 and Bit 1 to Bit 8 as the trigger sources. Bit 1 to Bit 8 appear as options when a logic input module is installed in a slot.

▶ See here.

Achievement Condition (Condition)

Set the achievement condition for each trigger source.

H	The signal level must be high.
L	The signal level must be low.
IN	The signal must be within the specified level range.
OUT	The signal must be outside of the specified level range.
–	The signal is not used as a trigger condition.

* IN and OUT are only selectable when the trigger source is an analog signal (CH1 to CH16).

Trigger Level (Level)

Set this item for each trigger source.

When the Achievement Condition Is H or L

Set the level for determining whether the trigger sources are high or low.

▶ See here.

When the Achievement Condition Is IN or OUT

An edge is detected when the trigger source enters (IN) or leaves (OUT) the specified level range. You can specify the level range settings for each analog signal trigger source.

▶ See here.

Trigger Hysteresis (Hys)

Set this item for each trigger source.

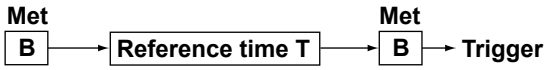
This item is the same as the hysteresis ▶ See here. of the simple trigger.

Trigger Hold-Off (Hold Off), Trigger Position (Position), Trigger Delay (Delay)

These items are the same as trigger hold-off ▶ See here., trigger position ▶ See here., and trigger delay ▶ See here. of the simple trigger.

Period Trigger (Enhanced)

The DL850/DL850V triggers on a specified period of occurrence of state condition B. The DL850/DL850V triggers when state condition B occurs again.



Trigger Source

You can use CH1 to CH16 and Bit 1 to Bit 8 as the trigger sources. Bit 1 to Bit 8 appear as options when a logic input module is installed in a slot.

▶ See here.

State Condition (B State)

To set state condition B, select the states of the trigger sources in relation to the trigger level.

Example

	State Condition B
CH1	H
CH2	L
CH3-	
Bit 1	L
Bit 2	H
……	…
Bit 8	X
CH4	X
……	…
CH16	X

H: The signal level must be high.
L: The signal level must be low.
X: The signal is not used as a condition.

Determination Mode (Mode)

Set what kind of relationship must be established between period T and the specified reference times (Time or T1 and T2) for the DL850/DL850V to trigger.

T < Time	Period T must be shorter than the reference time (Time).
T > Time	Period T must be longer than the reference time (Time).
T1 < T < T2	Period T must longer than reference time T1 and shorter than reference time T2.
T < T1, T2 <T	Period T must be shorter than reference time T1 or longer than reference time T2.

Reference Times (Time, T1, T2)

You can set the reference times (Time, T1, and T2) within the following ranges.

Setting	Selectable Range	Default	Resolution
Time	0.02 µs to 10000000.00 µs (10 s)	0.02 µs	0.01 µs
T1	0.02 µs to 9999999.99 µs	0.02 µs	
T2	0.03 µs to 10000000.00 µs (10 s)	0.03 µs	

Trigger Level (Level) and Trigger Hysteresis (Hys)

Set these items for each trigger source.

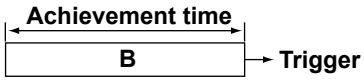
These items are the same as the trigger level ▶ See here. and hysteresis ▶ See here. of the simple trigger.

Trigger Hold-Off (Hold Off), Trigger Position (Position), Trigger Delay (Delay)

These items are the same as trigger hold-off ▶ See here., trigger position ▶ See here., and trigger delay ▶ See here. of the simple trigger.

Pulse Width Trigger (Enhanced)

The DL850/DL850V triggers according to a specified duration (achievement time) for which state condition B has been met. The timing of the triggering varies depending on the determination mode.



Trigger Source

You can use CH1 to CH16 and Bit 1 to Bit 8 as the trigger sources. Bit 1 to Bit 8 appear as options when a logic input module is installed in a slot.

▶ See here.

State Condition (B State)

To set state condition B, select the states of the trigger sources in relation to the trigger level.

Example

	State Condition B
CH1	H
CH2	L
CH3-	
Bit 1	L
Bit 2	H
……	…
Bit 8	X
CH4	X
……	…
CH16	X

H: The signal level must be high.
L: The signal level must be low.
X: The signal is not used as a condition.

Determination Mode (Mode)

Set what kind of relationship must be established between the state condition B achievement time and the specified reference times (Time or T1 and T2) for the DL850/DL850V to trigger.

B < Time	The DL850/DL850V triggers when the achievement time is shorter than the reference time (Time), and the state condition changes to not met.
B > Time	The DL850/DL850V triggers when the achievement time is longer than the reference time (Time), and the state condition changes to not met.
B TimeOut	The DL850/DL850V triggers when the achievement time is longer than the reference time (Time).
B Between	The DL850/DL850V triggers when the achievement time is longer than reference time T1 and shorter than reference time T2, and the state condition changes to not met.

Reference Times (Time, T1, T2)

You can set the reference times (Time, T1, and T2) within the following ranges.

Setting	Selectable Range	Default	Resolution
Time	0.02 µs to 10000000.00 µs (10 s)	0.02 µs 0.01 µs for B TimeOut	0.01µs
T1	0.01µs to 9999999.99µs	0.01µs	
T2	0.02µs to 10000000.00µs(10 s)	0.02 µs	

Triggering may not function properly when the interval between achievement times is less than 0.01 µs or when the duration of the achievement time is less than 0.01 µs (Typical).

Trigger Level (Level) and Trigger Hysteresis (Hys)

Set these items for each trigger source.

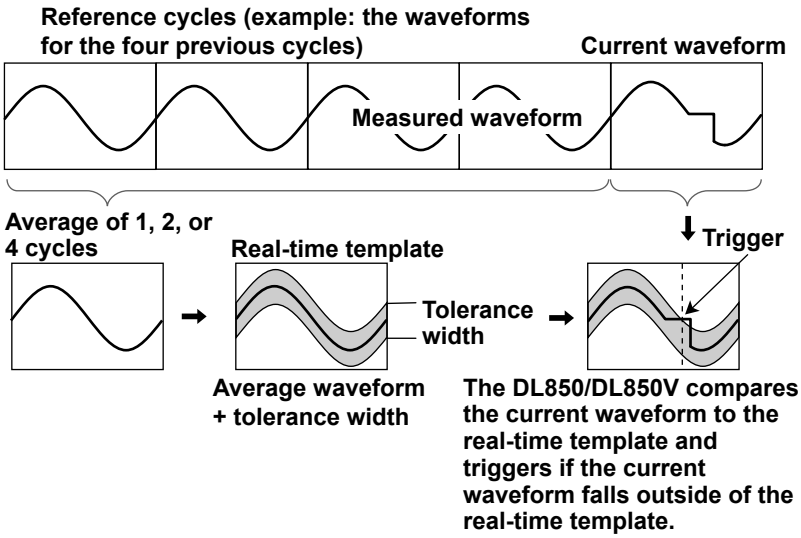
These items are the same as the trigger level ▶ See here. and hysteresis ▶ See here. of the simple trigger.

Trigger Hold-Off (Hold Off), Trigger Position (Position), Trigger Delay (Delay)

These items are the same as trigger hold-off ▶ See here., trigger position ▶ See here., and trigger delay ▶ See here. of the simple trigger.

Wave Window Trigger (Enhanced)

The DL850/DL850V creates real-time templates (Wave Window) using a number of cycles directly preceding the current waveforms. The DL850/DL850V compares the current waveforms to the real-time templates and triggers if one of the current waveforms falls outside of its real-time template.


Reference cycles (example: the waveforms for the four previous cycles)
Current waveform
Measured waveform
Average of 1, 2, or 4 cycles
Real-time template
Trigger
Tolerance width
Average waveform + tolerance width
The DL850/DL850V compares the current waveform to the real-time template and triggers if the current waveform falls outside of the real-time template.

Trigger Source

You can select the trigger sources from CH1 to CH16. The modules that you can use as sources for the Wave Window trigger are listed below. You cannot use other modules or temperature-measurement channels as sources.

701250 (HS10M12)	701251 (HS1M16)	701255 (NONISO_10M12)	701260 (HV (with RMS))
701261 (UNIVERSAL) (only voltage measurement)		701262 (UNIVERSAL (AAF)) (only voltage measurement)	
701270 (STRAIN_NDIS)	701271 (STRAIN_DSUB)	701275 (ACCL/VOLT)	720210 (HS100M12)

Template Channels (Condition)

Select which trigger sources to use to make real-time templates. The DL850/DL850V triggers if the condition of even one of the channels is met.

ON	Use
OFF	Don't use

Tolerance Width (Width)

To create a real-time template for a channel, set the distance from the averaged waveform (of 1, 2, or 4 cycles before the current waveform) that will be tolerated. The range within which you can set the distance varies depending on the type of signal being measured.

Signal Type	Selectable Range	Default	Resolution
Voltage	0.01 × the voltage scale to 10 × the voltage scale	0.01div	Same as the trigger level resolution ▶ See here.
Strain	1 µSTR to (measurement range) × 2 or 0.0005 mV/V to (measurement range) × 2	1µSTR 0.0005mV/V	
Acceleration	0.01 Unit to (Unit/div) × 10	10mUnit	

For example, when Width is set to 2V, the tolerance width is ±1 V around the averaged waveform.

Cycle Frequency (Cycle Frequency)

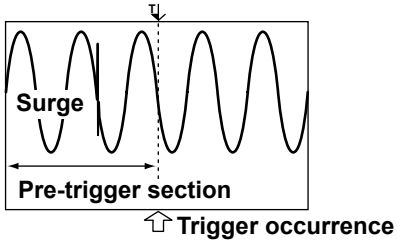
Set the trigger source frequency. If the actually frequency is within ±10% of the specified value, it is automatically tracked.
Selectable range: 40 to 1000 Hz. The default setting is 50 Hz.
Resolution: 0.1 Hz

Reference Cycles (Reference Cycle)

Select how many waveforms before the current waveform are used to create the real-time templates. When the sample rate is 500 kS/s and the number of channels used to make real-time templates is 9 or more, you can only set the number of cycles to 2. Even if you select 4 cycles, only two are used.

1	One previous waveform is used.
2	Two previous waveforms are used.
4	Four previous waveforms are used.

If a surge or other abnormal waveform occurs in the reference cycle, the abnormal waveform will be included in the averaged waveform, so the DL850/DL850V will trigger on the next normal waveform. This may make it appear is if the trigger has been delayed by a few cycles.



When you use the wave window trigger, we recommend that you set a pre-trigger length that is longer than the reference cycle so that you can observe waveform abnormalities that occur in the reference cycle.

Sync Channel (Sync. Ch)

Select the channel used to detect the points at which waveform comparison for the wave window trigger starts and stops. Select the synchronization channel by selecting Auto or a channel from CH1 to CH16 that has a module that the wave window trigger can be used with.

Auto

Of the modules that the wave window trigger can be used with, the module with the smallest number is automatically selected.
Level for detecting the start and end points: The center of the amplitude of the sync-channel signal measured for 0.5 seconds after the start of waveform acquisition.
Detection hysteresis: Same as the edge trigger hysteresis ▶ See here.

CH1 to CH16

Select a channel whose module can be used with the wave window trigger. If triggering does not function properly when you select Auto, you can specify an appropriate channel.
For the selected channel, you need to set the level for detecting the start and end points and set the detection hysteresis.

Level for Detecting the Start and End Points (Level) and Detection Hysteresis (Hysteresis)

If you set the sync channel to a channel from CH1 to CH16, you need to set the level for detecting the start and end points and set the detection hysteresis. These items are the same as the trigger level ▶ See here. and hysteresis ▶ See here. of the simple trigger.

Trigger Hold-Off (Hold Off), Trigger Position (Position), Trigger Delay (Delay)

These items are the same as trigger hold-off ▶ See here., trigger position ▶ See here., and trigger delay ▶ See here. of the simple trigger.

Operating Conditions of the Wave Window Trigger

You can use the wave window trigger with the following waveforms and settings. You cannot use the wave window trigger when the record length is 25 kpoint or less and the time axis setting is shorter than 10 ms/div.

Waveforms	AC waveforms and triangular waveforms between 40 kHz and 1 kHz. (The trigger cannot be used with rectangular waveforms, such as inverter waveforms, or waveforms with fast rising edges.)
Sample rate	10 kS/s to 500 kS/s
Acquisition mode	Normal
Trigger mode	Normal, Single, Single(N) When the trigger mode is Auto or Auto Level, it is difficult for the wave window trigger to occur.
Dual capture feature	OFF

5 Waveform Acquisition

Based on the data that has been stored in the acquisition memory, the DL850/DL850V performs various operations, such as displaying waveforms on the screen, computing, measuring cursors, and automatically measuring waveform parameters.
This chapter explains how to set the number of data points to store in the acquisition memory (the record length), how to enable or disable the sample data averaging feature, and so on.

Record Length (Record Length)

Record length refers to the number of data points that are stored to the acquisition memory for each channel. *Display record length* refers to the data points from the data stored in the acquisition memory that are displayed on the screen. Normally, the acquisition-memory record length and display record length are the same, but the time axis setting may cause them to differ. When you change the time axis setting, the sample rate and record length also change.
On the standard model of the DL850/DL850V, you can set the record length to a value between 1 kpoint and 250 Mpoint. On models with the /M2 option, you can set the length to up to 2 Gpoint. On models with the /HD0 option or /HD1 option and the /M2 option, when you enable hard disk recording, you can set the record length to up to 50 Gpoint. For details about the record lengths that can be set, see appendix 2 in the getting started guide, IM DL850-03EN.
Use a long time axis setting when you want to observe a phenomenon over a long period of time. When you want to observe a phenomenon at a high time resolution, set a long record length, and raise the sample rate. When the record length is long, computation and measurement processing take longer than when the record length is short.
The amounts of time for which you can record data to the acquisition memory when the record length is 2 Gpoint are listed below.

Sample Rate	In Seconds	In Minutes	In Hours	In Days
100 MS/s	20	0.33	0.0056	0.00023
10 MS/s	200	3.33	0.056	0.0023
1 MS/s	1800	30	0.50	0.021
100 kS/s	18000	300	5.0	0.21
10 kS/s	180000	3000	50	2.1
1 kS/s	1728000	28800	480	20
500 S/s	2593000	43217	720	30

The following limitations on waveform acquisition conditions and the number of waveforms that can be stored in the acquisition memory (the number of history waveforms) apply depending on the set record length.
▶ See here.

Notes about Setting the Record Length

- Increasing the record length automatically limits the number of channels that can be used. When some channels are unavailable, the number of channels that can be used appears in the record length soft key menu.
- When the acquisition mode is set to Average, the maximum record length is 5 Mpoint on standard models, 10 Mpoint on models with the /M1 option, and 25 Mpoint on models with the /M2 option.
- When the dual capture feature is being used, the maximum record length is 100 Mpoint on standard models, 500 Mpoint on models with the /M1 option, and 1 Gpoint on models with the /M2 option.
- The maximum record length during hard disk recording is 50 Gpoint (one channel).
- When the trigger mode is Auto, Auto Level, Normal, or N Single and the display is not in roll mode, you can only select a record length that is less than 5 Mpoint on standard models, 10 Mpoint on models with the /M1 option, or 25 Mpoint on models with the /M2 option.
- On the DL850/DL850V, record lengths are expressed in units of points. There are some products, such as the DL750, for which record lengths are expressed in units of words.

Acquisition Mode (Acquisition Mode)

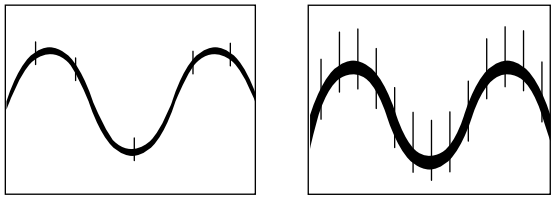
You can set the acquisition mode to one of the options below.

Normal Mode (Normal)

Displays waveforms without processing the sampled data.

Envelope Mode (Envelope)

The DL850/DL850V determines the maximum and minimum values among the data sampled at the maximum sampling rate for each module at a time interval that is twice the sampling period (the inverse of the sample rate) of Normal mode, saves the values as pairs in the acquisition memory, and uses the saved value pairs to display the waveforms. This mode is effective when you want to avoid aliasing, because the sample rate is essentially kept high regardless of the time axis setting. It is also effective when you want to detect glitches (narrow pulse signals) or when you want to display the envelope of a modulated signal.

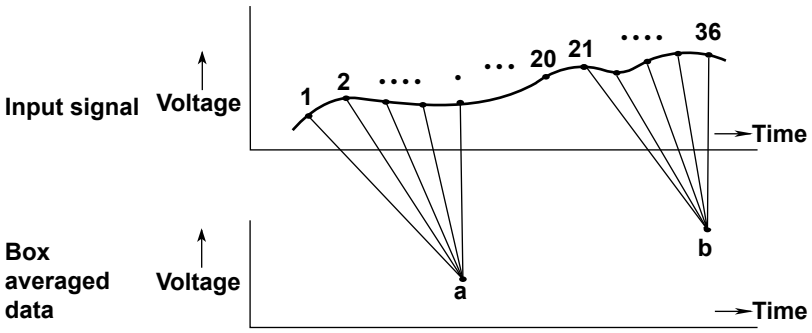


Normal mode **Envelope mode**

When the dual capture feature is used, captured waveforms cannot be displayed as envelope waveforms.

Box Average Mode (BoxAverage)

This mode can be used with the 701250 (HS10M12), 701255 (NONISO_10M12), and 720210 (HS100M12). The DL850/DL850V determines the moving averages of the data sampled at the maximum sample rate, saves them to the acquisition memory, and uses them to display waveforms. This mode is useful for removing small levels of noise from the input signal. It is also useful for removing the noise from a single-shot signal.



The number of data points that are averaged varies as indicated below depending on the sample rate.

Sample Rate (S/s)	Number of Data Points
100 M*	1 point
50 M	2 points
20 M	4 points out of 5
10 M	8 points out of 10
5 M	16 points out of 20
2 M	32 points out of 50
1 M	64 points out of 100
500 k	128 points out of 200
200 k	256 points out of 500
100 k or less	256 points out of the number of points equivalent to (100 M ÷ sample rate)

* The same as Normal mode

Averaging Mode (Average)

The DL850/DL850V acquires waveforms multiple times, averages the same time points relative to the trigger point, saves them in the acquisition memory, and uses them to display averaged waveforms. Averaging mode is useful when you want to remove random noise from waveforms.

The averaging method varies depending on the acquisition count.

When Acquisition Count Is Set to Infinity

Exponential average

$$An = \frac{1}{N}\{(N-1)An-1 + Xn\}$$

An: n^{th} averaged value
Xn: n^{th} measured value
N : Attenuation constant (2 to 256 in 2^n steps)

When Acquisition Count Is Set to a Value between 2 and 65536 (in 2^n steps)

Linear average

$$AN = \frac{\sum_{n=1}^{N} Xn}{N}$$

Xn: n^{th} measured value
N : Average count = acquisition count

- When waveforms are acquired in averaging mode, they are saved to the acquisition memory as a single record. This means that the history feature cannot be used.
- You cannot select averaging mode when:
  - The display is in roll mode.
  - The trigger mode is Single, N Single, or On Start.
  - The dual capture feature is being used.
  - Data is being recorded to a hard disk.
- To average waveforms that have been acquired in N Single mode, set the acquisition mode to Normal, and set the history feature's display mode to Averaging.
- Logic waveforms and CAN monitor module waveforms cannot be averaged.

Acquisition Count (Acquisition Count)

The ranges within which you can set the waveform acquisition count are indicated below. If you select Infinite, the DL850/DL850V continues waveform acquisition until you stop it using the START/STOP key. The default setting is Infinite. Changes to the number of acquisitions are not applied during waveform acquisition. They are applied after acquisition stops.

- When the acquisition mode is set to Normal, Envelope, or BoxAverage
  1 to 65536 (in steps of 1) or Infinite
- When the acquisition mode is set to Average.
  2 to 65536 (in 2^n steps) or Infinite

The number of waveforms that have been stored to the acquisition memory appears in the lower left of the screen.

Trigger Mode (Trigger Mode)

▶ See here.

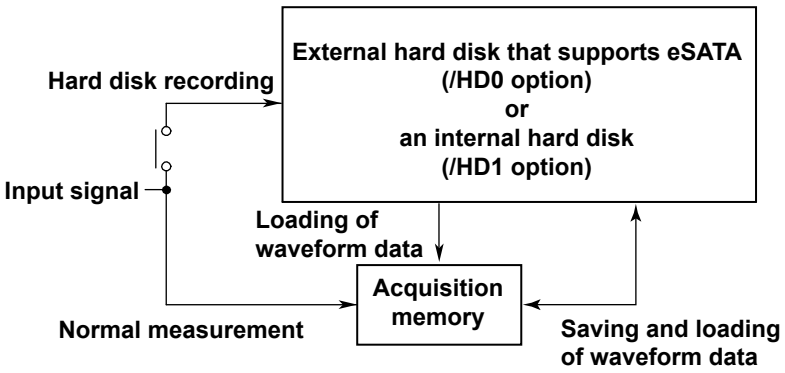
Hard Disk Recording (HD RecordCondition; optional)

When measurement starts, you can record data an external hard disk that supports eSATA (external Serial ATA; /HD0 option) or to an internal hard disk (/HD1 option).* The recorded data is saved to files automatically. You can load the data that has been saved.

* Models with the /HD0 option are equipped with eSATA connectors. You need to purchase a hard disk that supports eSATA separately. For information about supported hard disks, contact your nearest YOKOGAWA dealer. A single DL850/DL850V cannot be equipped with both the /HD0 and /HD1 option.

- The DL850/DL850V stops acquiring waveforms after it has acquired the amount of data that corresponds to the set record length. The maximum record length is 30 days.
- When you enable hard disk recording, the trigger mode is automatically set to On Start.
- Hard disk recording is possible for the numbers of channels, sample rates, set record lengths, and time axis settings listed below.

Number of Channels	Maximum Sample Rate	Set Record Length	Time Axis Setting
1	1 MS/s	1 Mpoint or more	1 s/div or more (the roll mode display area)
3	500 kS/s		
8	200 kS/s		
16	100 kS/s		



Recorded Data File (HD Recording Setup)

You can save data to a specific file name on a hard disk and add comments to it.
In hard disk recording, a folder for the current date is created on the specified drive, and the recorded-data files are saved to that folder.

- **File Name (File Name) and Comment (Comment)**

  You can set file names and comments. You can also use the auto naming feature to automatically assign file names.

  ▶ See here.

- **File Division (Data File Divide)**

  You can specify the number of files that the recorded data is divided into. You can use this feature to avoid creating large files that take time to process. You can specify the number of divisions, but the actual number of files that will actually be saved is a number close to the specified number.

- Before you turn on the DL850/DL850V, connect the external hard disk to the DL850/DL850V, and turn on the external hard disk. If you connect a hard disk or turn it on after you turn on the DL850/DL850V, the hard disk will not be detected. Also, when the external hard disk is on, do not disconnect its cable.
- Hard disk recording cannot be performed when the record length is less than 1 Mpoint.
- Hard disk recording cannot be performed when the acquisition trigger is on or when the dual capture feature is being used.
- Hard disk recording can only be performed when the trigger mode is set to On Start. It cannot be performed in other modes.
- When hard disk recording is enabled, you cannot use an external clock as the time base.
- When you start hard disk recording, cursor measurement and the automated measurement of waveform parameters stop.
- During hard disk recording, only starting and stopping of hard disk recording, the zoom display settings, and the protect feature are valid.
- The upper limit of the zoom factor during hard disk recording is the maximum zoom factor that can be displayed during hard disk recording.
- During hard disk recording, you cannot display history waveforms, loaded waveforms, or computed waveforms.
- You can perform the following operations on data that has been recorded to a hard disk. You cannot use the history feature.
  Cursor measurement, automated measurement of waveform parameters (up to 100 Mpoint), waveform zooming, computation, waveform data saving and loading, printing
- During hard disk recording, the DL850/DL850V may respond more slowly to operations.
- The maximum number of files that can be saved to a single folder is 1000.

Time Base (Time Base)

Under the initial settings, the DL850/DL850V samples the measured signals using the clock signal produced by its internal time-base circuit (internal clock). You can also use an external clock signal to control sampling. One data sample is stored to the acquisition memory at every pulse in the external clock signal. The external clock input is useful when you want to monitor the waveform using a clock signal that is in sync with the signal being measured.

Apply the external clock signal to the external-clock input terminal (EXT CLK IN) on the left panel. For the specifications of the external-clock input terminal, see the getting started guide, IM DL850-03EN.

Int	The internal clock signal is used as the time base (the TIME/DIV time axis setting is valid).
Ext	An external clock signal is used as the time base (the TIME/DIV time axis setting is invalid).

Pulses per Rotation (Pulse/Rotate)

When the time base is an external clock, you can specify how many pulses of the external clock signal (how many sampled data acquisitions) correspond to one mechanical rotation (or period). For example, if you set Pulse/Rotate to 100 pulses, when the record length is 1 kpoint, 10 rotations worth of sampled data will be acquired. When Pulse/Rotate is set to 1 pulse, each point of sampled data corresponds to a single rotation. The Pulse/Rotate setting only affects the horizontal-cursor measurement values and how the time axis is displayed on the screen. For example, if you set Pulse/Rotate to 100 pulses, when the record length is 1 kpoint, 1 div will correspond to 1 rotation. With these settings, if you move the cursor by 1 div, the measured horizontal value will only increase by 1.

Selectable range for pulses: 1 to 24000

Notes about Sampling Using an External Clock Signal

- You cannot acquire waveforms when the acquisition mode is set to Envelope or BoxAverage.
- You cannot display waveforms in roll mode.
- There is no function for dividing the frequency of the clock signal.
- The time axis cannot be changed. To change the time-axis display range, change the record length, or zoom in on the time axis.
- The measured time values in cursor measurements and automated measurements of waveform parameters indicate the number of clock signal pulses. For these measurements, units are not displayed.
- Hard disk recording cannot be used.
- The dual capture feature cannot be used.
- The trigger settings listed below are invalid.
  Hold-off, trigger delay, period trigger, pulse width trigger

Maximum Sample Rates for Each Module

If you set the sample rate of the DL850/DL850V to a rate that is higher than a module's maximum sample rate, because the data is updated at the module's maximum sample rate, all the data within the module's data update interval will be the same. The maximum sample rates for each module are listed below.

Module		Maximum Sample Rate	
		Internal Clock	External Clock
701250/701255		10 MHz	9.5 MHz
701251		1 MHz	1 MHz
701260/701270/701271/701275		100 kHz	100 kHz
701261/701262	(when measuring voltage)	100 kHz	100 kHz
	(when measuring temperature)	500 Hz	500 Hz
701280		25 kHz	25 kHz
701265		500 Hz	500 Hz
720210		100 MHz	9.5 MHz
720220		200 kHz	200 kHz
720230 (LOGIC)		10 MHz	9.5 MHz
720240 (CAN MONITOR)		100 kHz	100 kHz

Notes about Using the 16-CH Voltage Input Module

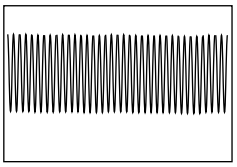
▶ See here.

Dual Capture (DUAL CAPTURE)

You can use dual capturing to simultaneously acquire waveform data (main waveform) in low-speed roll mode and at a high sampling rate (captured waveform). Dual capturing is useful during low-speed sampling when you are observing waveforms over a long period of time and want to capture fast phenomena at a high sample rate.

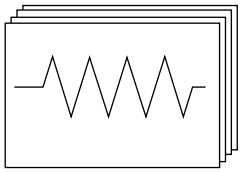
- When the waveform data is saved, captured waveforms are saved along with the main waveforms. When you load the main waveforms, the captured waveforms are also loaded.
- When the window for displaying captured waveforms (the dual capture window) is displayed, cursor measurement, automated measurement of waveform parameters, and statistical processing can be performed on the captured waveforms. Measured captured-waveform values are displayed in italics. When captured waveforms are not displayed, the measurement and processing are performed on the main waveforms. When the waveforms that are measured and processed change, the measured values are reset.

Main waveforms
(low-speed sampling)
Roll mode display (up to 1 Gpoint)

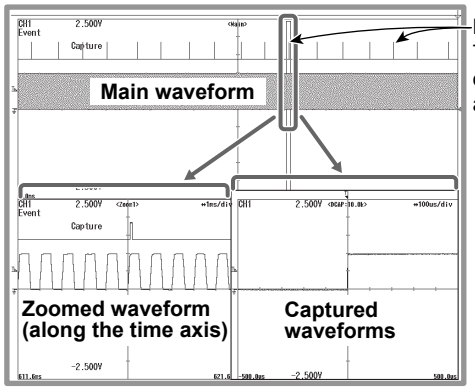


Sample rate:
100 kS/s or less

Captured waveforms
(high-speed sampling)
Update mode display



Sample rate:
Faster than that of the main waveform



Events
The points where triggering occurred during dual capturing are displayed as events.

Because there is not enough sampled data, the shape of the waveform may not be displayed correctly.

Because the data is sampled at a high speed, the correct shape of the waveform is displayed.

Channels That Dual Capturing Is Performed On

Normally, dual capturing is performed on all the channels detected by the DL850/DL850V. However, under the following conditions, dual capturing is only performed on channels whose displays are turned on.

- When hard disk recording is enabled
- When an increase in the record length of the main waveforms places a limitation on the number of channels that can be used

In both cases, dual capturing is not performed on 16-CH Voltage Input Module sub channels whose input coupling is set to OFF.

Turning Dual Capturing On and Off (Display)

Set whether to enable or disable dual capturing.

- ON: Dual capturing is enabled.
- OFF: Dual capturing is disabled.

Main Waveform Acquisition Settings

- Time axis setting: A value from 100 ms/div to 3 days/div
  ▶ See here.
- Main waveform sample rate: 100 kS/s or slower
  ▶ See here.
- Acquisition mode: Normal, Envelope, or BoxAverage
  ▶ See here.

Captured-Waveform Acquisition Settings (Capture Setup)

- Time axis setting (Time/div): A value from 1 µs/div to 500 ms/div (in 1-2-5 steps) or 1 sec/div to 1 min/div
- Capture length (Capture Length): 5 kpoint, 10 kpoint, 25 kpoint, 50 kpoint, 100 kpoint, 250 kpoint, or 500 kpoint
- Capture mode (Capture Mode): Auto or On Start

Auto (Auto)	The DL850/DL850V continues waveform acquisition until you stop it using the START/STOP key.
Instant start (On Start)	After the amount of data that corresponds to the set record length or 10 div worth of data is acquired, waveform acquisition stops.

- Main-waveform sample rate < captured-waveform sample rate
  The sample rates must be set so that the sample rate of the captured waveforms is faster than the sample rate of the main waveforms.

Trigger Condition

When dual capturing is enabled, the trigger conditions apply to the captured waveforms. When the trigger conditions are met, the DL850/DL850V triggers and acquires the captured waveforms.

Action (Action Setup)

You can make the DL850/DL850V perform a specified action when it triggers and acquires captured waveforms.
▶ See here.

Captured-Waveform Display Number (Select Number)

You can select the number of a captured waveform and display it. The trigger time of the selected waveform appears to the lower left of the waveform display area.

When Capture Mode Is Set to Auto

The numbers that you can select vary as indicated below. You can select and display the numbers when waveform acquisition is stopped.

Current, −1, −2, ...

Current: the most recent waveform, −1: one waveform before the most recent waveform, −2: two waveforms before the most recent waveform, ...

When Capture Mode Is Set to On Start

The numbers that you can select vary as indicated below. You can select and display the numbers even during waveform acquisition.

Current, 1, 2, ...

Current: the most recent waveform, 1: the oldest waveform, 2: the second oldest waveform, ...

Displaying a List of Captured Waveforms (List)

When waveform acquisition is stopped, you can display a list of captured-waveform numbers and trigger times. You can select a waveform that you want to display from the list and display it.

Zooming Captured Waveforms (Mag, Position)

Zooms the displayed captured waveforms.

Zoom Factor (Mag)

You can set the zoom factor to a value between the time axis setting at the time when the captured waveform was acquired to the minimum captured-waveform time-axis setting of 1 µs/div.

Position (Position)

The captured waveform is zoomed around the position that you set here.

Turning the Display of the Capture Window On and Off (Window ON and OFF)

You can set whether to display the dual capture window. When the dual capture window is displayed, cursor measurement, automated measurement of waveform parameters, and statistical processing are performed on the captured waveforms. When the dual capture window is not displayed, measurement and processing are performed on the main waveforms.

- ON: The dual capture window is displayed.
- OFF: The dual capture window is not displayed.

Display Ratio of the Main Window (Main Ratio)

▶ See here.

Window Layout (Window Layout)

Set the display position of the dual capture window.

- Side: Horizontal
- Vertical: Vertical

Format (Format)

Set the display format of the dual capture window.

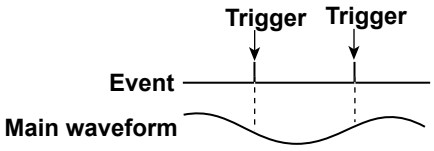
Main (Main): The same format as the main window

1, 2, 3, 4, 6, 8, 12, 16: The dual capture window is broken up into the specified number of divisions.

Event Display (Event Display)

You can display the points where triggering occurred during dual capturing as events. When the waveform data is saved, the event data is saved along with the main waveforms. When you load the main waveforms, the events are also loaded.

The locations of captured waveforms are indicated.



Waveforms That Are Captured (Allocation)

The waveforms of the channels whose check boxes are selected in the allocation window and whose displays are turned on are displayed.

- When the main waveform acquisition mode is Average, dual capturing cannot be executed.
- Dual capturing cannot be performed during hard disk recording.
- During dual capturing, the DL850/DL850V may respond more slowly to operations.
- Use the internal clock as the time base when you perform dual capturing. You cannot perform dual capturing when an external clock is being used.
- When you perform dual capturing, all the previous waveform data is deleted.
- Dual capturing cannot be performed on X-Y waveforms.
- The accumulate function cannot be used.
- Computation cannot be performed on captured waveforms.
- When the automated measurement of waveform parameters is enabled, the time it takes for the DL850/DL850V to enter the trigger-ready state may become longer after a captured waveform is acquired.
- The history feature cannot be used on waveform data acquired through dual capturing.

Waveform Acquisition (START/STOP)

When you start waveform acquisition, the DL850/DL850V stores waveform data to the acquisition memory and updates the displayed waveforms each time it triggers. The acquisition memory is divided into many areas based on the set record length, and the maximum number of acquirable waveforms are stored in the memory. You can recall past waveforms that are stored in the memory by using the history feature when waveform acquisition is stopped.

DL850/DL850V Operation When the Acquisition Mode Is Set to Averaging

- Averaging stops when you stop acquisition.
- If you start acquisition again, averaging starts from the beginning.

START/STOP Key Operations during Accumulation

- Accumulation stops when you stop waveform acquisition.
- When you start acquisition again, the displayed waveforms up to that point are cleared, and accumulation restarts from the beginning.

The START/STOP Key Is Disabled:

- When the DL850/DL850V is in remote mode.
- When the DL850/DL850V is printing to a printer, when it is being set up automatically, or when it is accessing a storage medium.

- If you change the waveform acquisition conditions and start waveform acquisition, the past data stored in the acquisition memory is cleared.
- You can use the snapshot feature to retain the displayed waveform on the screen. This feature allows you to update the display without having to stop waveform acquisition.
- Regardless of the trigger settings, you can make the DL850/DL850V trigger by pressing the MANUAL TRIG key on the front panel.

6 Display

Window Types (DISPLAY)

The DL850/DL850V has the following types of windows.

T-Y (Time axis) Waveform Display Window

- Main window
  Displays normal waveforms, which are not magnified
- Zoom window (Zoom1 and Zoom2)
  Displays zoomed waveforms according to the settings specified using the ZOOM key

X-Y Window (Window 1 and Window 2)

Displays X-Y waveforms according to the settings specified using the X-Y key

FFT Window (FFT1 window and FFT 2 window)

Displays FFT waveforms according to the settings specified using the FFT key

Dual Capture Window

Appears when the dual capture feature is used

Extra Window

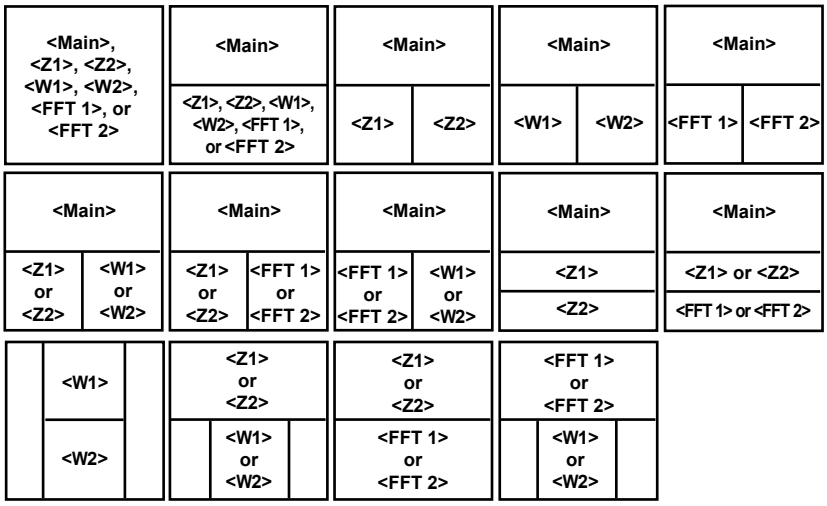
This window displays cursor-measurement values, automated measurement values of waveform parameters, and so on. It can be used when values overlap with waveforms and are difficult to see.

Switching the Menu Area Display

You can switch between the full-screen waveform display, the channel information display, and the waveform numeric-monitor display.

Display Pattern Examples

The main display patterns are shown in the figure below.



- Zoom1 and Zoom2 are abbreviated to Z1 and Z2.
- You can create patterns in which the main window is not displayed.
- The dual capture window is also displayed as shown in the patterns above.

Display Format (Format)

You can evenly divide the T-Y waveform display window so that you can easily view input waveforms and computed waveforms. You can set the number of divisions to one of the values listed below.
1, 2, 3, 4, 6, 8, 12, or 16

The number of displayed points in each division varies depending on the number of divisions. Even if the number of displayed points changes, the vertical resolution does not change. The number of displayed points when only the Main window is displayed is as follows:

Divisions	Displayed Points	Divisions	Displayed Points	Divisions	Displayed Points	Divisions	Displayed Points
1	656 points	2	328 points	3	218 points	4	164 points
6	109 points	8	82 points	12	54 points	16	41 points

Extra Window (Extra Window)

When waveforms and measured values overlap and are difficult to see, you can use the extra window to display them separately. The extra window appears below the T-Y waveform display window. The following values appear in the extra window.

- Cursor-measurement values
- Automated measurement values of waveform parameters
- The digital values of each channel (only during roll mode display)

Height of the Extra Window

Set the height of the extra window.
OFF: The extra window is not displayed.
1 to 8: The extra window is set to the selected height.
Auto: The extra window appears automatically when you perform cursor measurements and automated measurements of waveform parameters.

- The number of displayed points on the T-Y waveform display window varies depending on the height of the extra window. Even if the number of displayed points changes, the vertical resolution does not change.
- When the extra window is displayed, depending on the Zoom Format, the scale values may overlap and be difficult to read.

Grid (Graticule)

You can set the window grid to one of the following options.

- : Displays the grid using broken lines
- : Displays the grid using crosshairs
- : Displays a frame

Turning the Scale Value Display On and Off (Scale Value)

You can display the upper and lower limits (scale values) of each waveform's vertical or horizontal axes.

- ON: Displays the scale values
- OFF: Does not display the scale values

Waveform Arrangement, Color, and Display Gr. (Trace Setup)

You can set the following items for the input channels (CH1 to CH16) of the modules installed in the slots and for the computation channels (Math1 to Math8). You cannot configure settings for input modules that are not installed.

Allocation Mode (Allocation Mode)

Select which channels to display in which window divisions (zones).

- **Auto**

  The waveforms whose displays are turned on are arranged by number from the top of the window.

- **User**

  The waveforms are arranged according to the settings configured for Zone.

Moving Input Channels (CH)

You can move input and computation channels. To move a channel, remove it from the list, and then select it in the location that you want to move it to.

Display Color (Color)

You can set the display color of each of the waveforms to one of 16 colors.
You can assign all waveforms regardless of whether their displays are turned on.

- You can set the colors of each of the sub channels on the 16ch Voltage input and CAN bus monitor modules.
- Because logic input modules are not displayed as individual bits but are instead displayed as single channels, a logic input channel can only have one color assigned to it.

Zone (Zone)

When Allocation Mode is set to User, you can specify which division of the screen (zone) to display each of the waveforms in. You can assign all waveforms regardless of whether their displays are turned on.

- You can assign zones to each of the sub channels on the 16ch Voltage input and CAN bus monitor modules.
- Because logic input modules are not displayed as individual bits but are instead displayed as single channels, a logic input module can only be assigned to one zone.

Display Groups (Select Display Gr.)

When modules, such as 16-CH Voltage Input Modules, that have multiple channels (sub channels) are installed, you can divide the channels into groups and display them. You can divide the channels into up to four groups.

- You can assign the same channel to multiple groups.
- You cannot assign the following channels to separate groups.
  - The bits of a single logic input module

Trace Label Display (Trace Label)

You can display waveform labels next to the displayed waveforms. If the waveform display is narrow because of the display format settings, labels may not be displayed.

- ON: Displays labels
- OFF: Does not display labels

Level Indicator

A level indicator that shows the levels of the waveforms whose displays are turned on appears on the right side of the waveform display area. It shows the current levels of the sampled data.

Interpolation Method (Dot Connect)

When the number of data points is within the interpolation zone of the T-Y waveform display,* the DL850/DL850V displays waveforms by interpolating between sampled data points.

* Interpolation zone refers to the condition in which a given number of data points are not contained in the 10 div along the time axis. The number of data points that define the interpolation zone varies depending on the display record length and zoom ratio.

You can set the interpolation method to one of the options below.

- **OFF**

  Displays the data using dots without interpolation.
- **Sine Interpolation (Sine)**

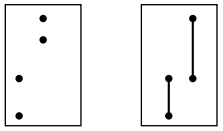
  Interpolates a sine curve between two points using the (sinx)/x function. This method is suitable for the observation of sine waves.
- **Linear Interpolation (Line)**

  Linearly interpolates between two points.
- **Pulse Interpolation (Pulse)**

  Interpolates between two points in a staircase pattern.

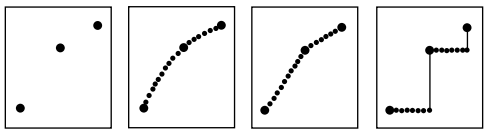
Outside of the Interpolation Zone

If the interpolation method is set to Sine, Line, or Pulse, the dots are connected vertically.
If the number of data points is 2002 or greater, the DL850/DL850V determines the P-P compression values (the maximum and minimum sampled-data values in a given interval), and displays vertical lines (rasters) connecting each pair of maximum and minimum P-P compression values.



OFF **Sine/Line/Pulse**

In the Interpolation Zone



OFF **Sine** **Line** **Pulse**

The interpolation method is set to Pulse when:

- The input signal is a logic signal.
- The acquisition mode is Envelope.

Setting the Number of Data Points to Use for Waveform Display (Decimation)

When the T-Y waveform display is not in the interpolation zone and the interpolation method is not set to OFF, P-P compressed values are displayed.
When the T-Y waveform display is not in the interpolation zone and the interpolation method is set to OFF or when the X-Y waveform display is shown, the DL850/DL850V displays the acquired data without P-P compression by removing the data between fixed intervals. You can set the number of points to use to display waveforms to one of the options listed below.
2k, 100k

- **When 2k Is Selected**

  When the record length exceeds 2 kpoint, the DL850/DL850V removes data until there are only 2 kpoint and displays two points on each vertical line. When the record length is less than 2 kpoint, all the points are displayed.

- **When 100k Is Selected**

  When the record length exceeds 100 kpoint, the DL850/DL850V removes data until there are only 100 kpoint and displays 100 points on each vertical line. When the record length is less than 100 kpoint, all the points are displayed.

During hard disk recording and roll mode display, if there are more than 100 points of data per div, the maximum and minimum values for specified intervals of data are displayed through linear interpolation.

Accumulation (Accumulate)

Ordinarily, momentary waveform anomalies are difficult to recognize because the displayed waveform is updated whenever the trigger is activated. In waveform accumulation, older waveforms remain on the screen for a period of time that is longer than the waveform update period, so that older waveforms remain while new waveforms continue to appear. The specified number of accumulated waveforms are displayed with gradually decreasing intensity.

- ON: Waveforms are accumulated.
- OFF: Waveforms are not accumulated.

Count (Count)

Set the number of accumulated waveforms to display. Waveforms will accumulate infinitely if you choose Infinite.
Selectable range: 2 to 128 waveforms (in 2^n steps). The default setting is 16.

Clearing Accumulated Waveforms

You can clear accumulated waveforms by pressing the CLEAR TRACE key.

- Automated measurement of waveform parameters and GO/NO-GO determination are performed on the most recent waveform.
- If you press START/STOP to stop waveform acquisition, accumulation stops. When you restart waveform acquisition, accumulation resumes from the condition that it was in when it was stopped.
- The built-in printer does not show the intensity differences between accumulated waveforms.
- When Accumulate is set to ON, you cannot change the settings of the history feature.
- When Accumulate is set to ON, even if you change the display format, the waveforms that are currently on the screen are not cleared. To clear waveforms, press CLEAR TRACE.
- You cannot set accumulate to ON in the roll mode display.
- When you set accumulate to OFF, the accumulated waveforms are cleared. To redisplay the waveforms, use the history feature, and select the record number of the waveforms that you want to display. You can only select waveforms that have record numbers. You cannot display earlier waveforms.
- If the DL850/DL850V does not trigger when the trigger mode is set to Normal, the waveform intensity is retained until the next time the DL850/DL850V triggers.

Manual Event (Manual Event)

Indicates the positions of manually input events. You can only input manual events during hard disk recording or when the dual capture feature is enabled. You can input manual events by applying a high/low signal to the external start/stop input (EXT I/O) terminal or by turning a switch contact on and off. You can enter up to 1000 events. For the specifications of the EXT I/O terminal, see section 5.5 in the getting started guide, IM DL850-03EN.

Switching the Menu Area Display

When the setup menu is displayed and you press the ESC key, the menu disappears, and the display switches to the full-screen waveform display. If you press the ESC key again, the channel information of the waveforms whose displays are turned on appears. If you press the ESC key yet again, the numeric monitor for the waveforms whose displays are turned on appears. Each time you press the ESC key, the display switches between the full-screen waveform display, the channel information display, and the numeric-monitor display.

Full-Screen Waveform Display

The menu disappears, and the waveform display area expands horizontally.

Channel Information

The following items are displayed.

However, as the number of displayed channels increases, some items may be omitted.

- Voltage measurement: V/div, input coupling, probe attenuation (type), bandwidth limit
- Temperature measurement: Temperature/div, thermocouple type, bandwidth limit
- Strain measurement: µSTR/div (or [mV/V]/div), measurement range, bandwidth limit
- Acceleration measurement: Acceleration/div, gain, input coupling, bias
- Frequency measurement: Value/div, measurement mode, preset

Numeric Monitor

The level indicator values for each channel appear in the numeric monitor display. The numeric monitor display is updated at approximately every 0.5 s.

Size of the Channel-Information and Numeric-Monitor Display Area (Ch. Information)

You can set the size of the display area that appears when you switch from the menu to the channel-information or numeric-monitor display.

- Full: Full screen
- Narrow: Width of the menu (displayed in the location of the menu)
- Wide: Displayed on the right half of the screen

7 Displaying X-Y Waveforms

You can view the correlation between two waveform levels by assigning the level of one waveform to the X-axis (horizontal axis) and the level of the other waveform to the Y-axis (vertical axis). There are two X-Y waveform windows, and you can display four pairs of waveforms in each window (for a total of eight pairs).
You can perform cursor measurements on the displayed X-Y waveforms. You can also observe T-Y (time axis) waveforms and X-Y waveforms simultaneously.

Turning the X-Y Window Display On and Off (Display)

You can select whether to display each X-Y window.

- ON: Displays the X-Y window
- OFF: Does not display the X-Y window

Eight Pairs of X-Y Waveforms (Setup)

You can display XY1 to XY4 in window 1 and XY5 to XY8 in window 2. You can configure the display settings of a total of 8 X-Y waveforms. You can configure the following settings for each X-Y waveform.

Display (DISPLAY)

You can select whether to display each X-Y waveform.

- ON: Displays the X-Y waveform
- OFF: Does not display the X-Y waveform

X Trace and Y Trace (X Trace and Y Trace)

For XY1 to XY4 and XY5 to XY8, you can select which waveforms to assign to the X and Y axes from the following options.

CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8

1 You can select the channel of an installed module. However, you cannot select the channel of a logic module.
2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.

- An X-Y waveform cannot be displayed if the waveforms assigned to its X and Y axes have different sample rates.
- An X-Y waveform cannot be displayed if it is a combination of a sub channel on the 16-CH Voltage Input Module and a normal channel. You can display an X-Y waveform of two sub channels that have the same sample rate. The same limitation that applies to the 16-CH Voltage Input Module also applies to CAN bus monitor modules.
- An X-Y waveform can be displayed if it is a combination of a sub channel on the 16-CH Voltage Input Module and a sub channel on a CAN bus monitor module and if the two sub channels have the same sample rate.
- X-Y waveforms can be created from normal T-Y waveforms. They cannot be created from zoomed waveforms.
- Logic waveforms and event waveforms cannot be used to make X-Y waveforms.
- You cannot create an X-Y waveform using one trace whose horizontal-axis unit is time and another trace whose horizontal-axis unit is frequency.

Start Point and End Point (Start Point and End Point)

You can set the start and end points of the X-Y waveforms on the T-Y waveforms. You can set different start and end points for each X-Y window.
Selectable range: ±5 div from the center of the T-Y waveform window

Pen Marker (Pen Marker)

You can display a pen marker on an X-Y waveform whose display is turned on. It shows the current sampled point of the waveform.

Clearing Waveforms at Acquisition Start (Trace clear on Start)

Choose whether to clear the current X-Y waveforms when waveform acquisition is started through the pressing of the START/STOP key.

- ON: X-Y waveforms are cleared.
- OFF: X-Y waveforms are not cleared.

Display Ratio of the Main Window (Main Ratio)

▶ See here.

Window Layout (Window Layout)

Set the display position of the X-Y window.

- Side: Horizontal
- Vertical: Vertical

Combine Display (Combine Display)

Choose whether to combine the two X-Y windows into one window.

- ON: The windows are combined.
- OFF: The windows are not combined.

Interpolation Method (Dot Connect)

When the number of data points is within the interpolation zone of the X-Y waveform display,* the DL850/DL850V displays waveforms by interpolating between sampled data points.

* Interpolation zone refers to the condition in which a given number of data points are not contained in the X-Y waveform display. The number of data points that define the interpolation zone varies depending on the display record length.

You can set the interpolation method to one of the options below.

- **OFF**

  Displays the data using dots without interpolation.
- **Linear Interpolation (Line)**

  Linearly interpolates between two points.

Diagram Explaining the Interpolation Method

▶ See here.

Setting the Number of Data Points to Use for Waveform Display (Decimation)

In the X-Y waveform display, the DL850/DL850V displays the acquired data by removing the data between fixed intervals. You can set the number of points to use to display waveforms to one of the options listed below.
2k, 100k

Detailed Explanation

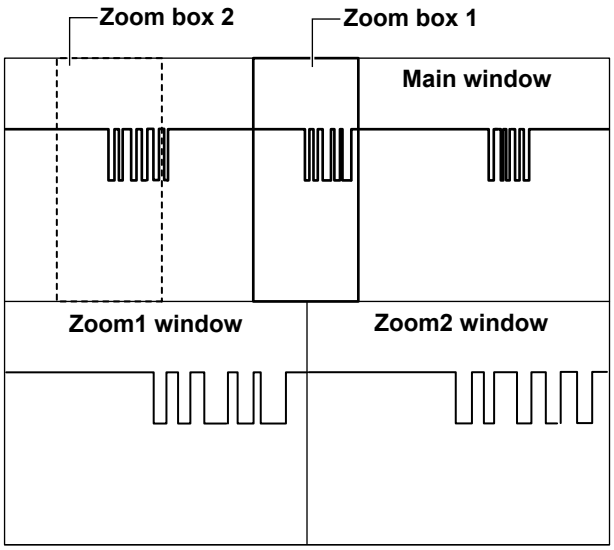
▶ See here.

- To zoom in or out on an X-Y waveform, change the upper and lower limits (Upper and Lower) of the channel that you want to zoom, or change the vertical zoom (V Zoom).
- On voltage input modules, to change the displayed position of an X-Y waveform, change the positions of the channels that it is based on.

8 Zooming in on Waveforms

You can magnify displayed waveforms along the time axis. The zoomed waveforms of two locations can be displayed simultaneously (the dual zoom feature). You can also specify which channel you want to zoom in on. You cannot zoom if the number of displayed points on the screen is less than or equal to 100.

Example of the Dual Zoom Display



If the Zoom1 or Zoom2 waveform window and the main waveform window (Main) are displayed at the same time, a zoom box appears in the Main window so that you can check the zoom position.

Vertical Zoom

You can magnify displayed waveforms along the vertical axis by using the menu that appears when you press a CH key.

▶ See here.

Zoom Window Display (Display)

You can set whether to display each of the zoom windows, Zoom1 and Zoom2. When a zoom window is displayed, a zoom bar appears at the top of the screen. This bar indicates what part of Main window is being zoomed in on.

- ON: Displays the zoom windows
- OFF: Does not display the zoom windows

Zoom Source Window (Zoom2 Source)

Select the waveforms that you want to enlarge in the Zoom2 window.

- Main (Main): Main window waveforms
- Zoom1: Zoom1 window waveforms

Zoom Factor (MAG knob)

Use the Mag knob to set the zoom factor. You can set separate horizontal zoom factors for Zoom1 and Zoom2. The zoom-window time-axis setting changes automatically based on the specified zoom factor.

Selectable Range

Two times the time axis setting (TIME/DIV) of the Main window to the point where the number of data points in the zoom window reaches 10 points per div.

- When an external clock signal is being used as the time base, you can select one of the following magnifications. You can select any magnification up to the point where the number of data points in the zoom window reaches 10 points per div.
  Up to 1000000 in 1-2.5-5 steps (×2, ×2.5, ×5, ×10, ×25, ×50, ×100, ×250, ×500, ×1000, ×2500, and so on)
- The upper limit of the zoom factor during hard disk recording is the maximum zoom factor that can be displayed during hard disk recording.

Position (Zoom POSITION knob, Zoom1 Position, Zoom2 Position)

You can set the zoom position (position) using the zoom POSITION knob or the jog shuttle. Taking the horizontal center of the main window to be 0 div, set the center position of the zoom boxes in the range of −5 to 5 div. In the Main window, the box with solid lines is for Zoom1, and the box with dashed lines is for Zoom2. Waveforms are magnified around the centers of the zoom boxes.

The Z1 or Z2 indicator on the front panel illuminates to show when the Zoom1 or Zoom2 window can be moved by the Mag or zoom POSITION knob.

Zoom Link

If you press the Mag knob or zoom POSITION knob so that the Z1 and Z2 indicators both light, you can move the zoom boxes while maintaining the spatial relationship between them. The relationship between the zoom factors is also maintained.

Display Ratio of the Main Window (Main Ratio)

Set the size of the main window in relation to the overall waveform display area.

- 50%: The main window appears in the upper half of the screen.
- 20%: The main window appears in the upper 20% screen.
- 0%: The main window is not displayed.

Window Layout (Window Layout)

You can select the layout of the two zoom windows.

- Side: Horizontal
- Vertical: Vertical

Display Format (Format Zoom1 and Format Zoom2)

Select how to display the zoom windows from one of the options listed below. If you select a number, the zoom windows are divided evenly, and waveforms are displayed within the divisions.

- Main: Same format as the Main window
- 1, 2, 3, 4, 6, 8, 12, 16

Moving the Zoom Position to the Latest Position (Move Zoom1 to Front and Move Zoom2 to Front)

You can move the position of one of the zoom boxes to the right side of the screen (where the most recent data is). When the waveform flows from the right to the left of the screen, as in roll mode, you can zoom in on the waveform where it starts from, on the right side of the screen. These menu items do not appear when the source waveform of the Zoom2 window is set to Zoom1.

Auto Scroll (Auto Scroll)

This feature automatically moves the zoom position in the specified direction. You can view the waveform and stop scrolling at the appropriate position.

⏮	Zooms in on the left edge of the Main window
⏭	Zooms in on the right edge of the Main window
◀	Starts scrolling to the left
▶	Starts scrolling to the right
■	Stops scrolling

Speed (Speed)

You can select the auto scrolling speed.

Selectable range: 1 to 10. The default setting is 4.

Waveforms That Are Zoomed (Allocation)

The waveforms of the channels whose check boxes are selected in the allocation window and whose displays are turned on are displayed.

9 Cursor Measurement

You can move cursors on the waveforms displayed on the screen to view the measured values at the points where the cursors intersect the waveforms.

Window Selection (Select Window)

Select the window to perform cursor measurement in. This option appears when X-Y or FFT waveforms are being displayed.

- T-Y: Displays T-Y waveform cursor-measurement values.
- X-Y: Displays the cursor-measurement values for the waveform in an X-Y window.
- FFT: Displays the cursor-measurement values for the waveform in an FFT window.

T-Y Waveforms

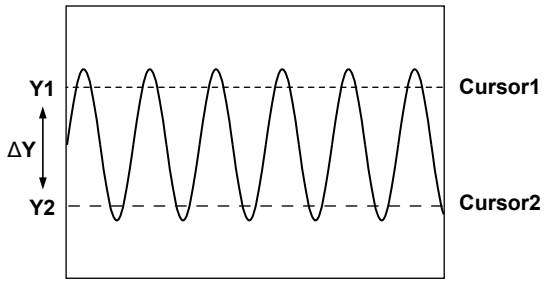
Cursor Types (Type)

The following types of T-Y waveform cursors are available.

- OFF: Cursor measurement is not performed.
- Horizontal cursors (Horizontal): Two horizontal cursors are used to measure vertical values.
- Vertical cursors (Vertical): Two vertical cursors are used to measure time values.
- Horizontal and vertical cursors (H & V): Two horizontal cursors and two vertical cursors are used to measure vertical and time values.
- Marker cursors (Marker): Four marker cursors that move on the waveform are used to measure waveform values.
- Angle cursors (Degree): Two angle cursors are used to measure angles.

Horizontal Cursors (Horizontal) - T-Y waveforms

Two dashed lines (horizontal cursors) appear on the horizontal axis. You can measure the vertical value at the position of each horizontal cursor and measure the level difference between the horizontal cursors.



Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.

CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8

1 You can select the channel of an installed module. You cannot select the channel of a logic module.
2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.

Moving the Cursors (Cursor1/Cursor2)

Use Cursor1 and Cursor2 to move the cursors.

Taking the center of the waveform display window to be 0 div, you can move the cursors within the range of −5 to 5 div in 0.01 div steps.

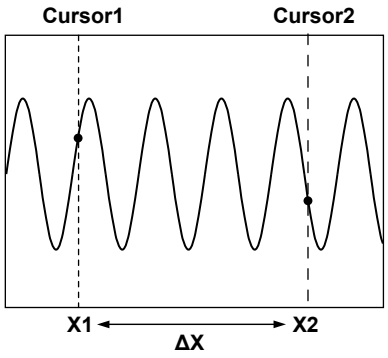
Measurement Items (Item Setup)

You can measure the following vertical values at the cursor positions.

Y1	Vertical value at Cursor1
Y2	Vertical value at Cursor2
ΔY	Difference between the vertical values of Cursor1 and Cursor2

Vertical Cursors (Vertical) - T-Y waveforms

Two straight dashed lines appear on the vertical axis (these are the vertical cursors). You can measure the time between the trigger position and each cursor, the time difference between the two cursors, and the reciprocal of the time difference between the two cursors. You can also measure the vertical signal value at each cursor position and the level difference between the two cursors.



Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.
CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8, All[4]

1 You can select the channel of an installed module.
2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel.
4 Cursor measurement is performed on all channels. However, measured values that do not fit on the screen are not displayed.

Moving the Cursors (Cursor1/Cursor2)

Use Cursor1 and Cursor2 to move the cursors.
Taking the center of the waveform display window to be 0 div, you can move the cursors within the range of −5 to 5 div in steps of the following size: Time/div × 10 ÷ display record length.

Measurement Items (Item Setup)

You can measure the following horizontal values at the cursor positions.

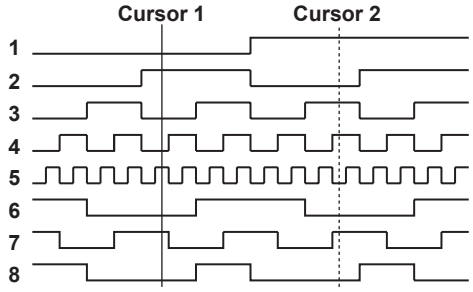
X1	Time value at Cursor1
X2	Time value at Cursor2
ΔX	Difference between the time values of Cursor1 and Cursor2
1/ΔX	Reciprocal of the difference between the time values of Cursor1 and Cursor2
Y1	Vertical value at the intersection of Cursor1 and the waveform[1]
Y2	Vertical value at the intersection of Cursor2 and the waveform[2]
ΔY	Difference between the vertical values at the intersections of the waveform with Cursor1 and Cursor2[2]

1 When Trace is set to All, the values for the channels of all installed modules, the sub channels, and the Math channel are measured.
2 This option does not appear when Trace is set to All.

Example of Logic Signal Measurement

When you measure logic waveforms using vertical cursors, the measured values of Y1 and Y2 are determined in the manner shown below.

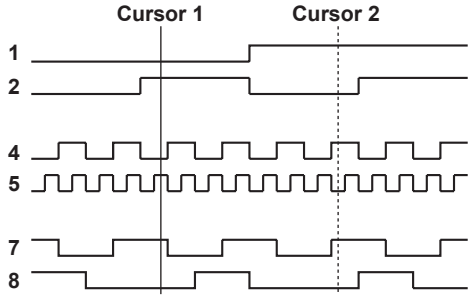
When No Bits Are Turned Off



• When the cursor order is 1->8
Bit Y1: 01001010
Y2: 10110010
Hex Y1: 4A
Y2: B2

• When the cursor order is 8->1
Bit Y1: 01010010
Y2: 01001101
Hex Y1: 52
Y2: 4D

When Some Bits Are Turned Off



• When the cursor order is 1->8
Bit Y1: 01-01-10
Y2: 10-10-10
Hex Y1: 16
Y2: 2A

• When the cursor order is 8->1
Bit Y1: 01-10-10
Y2: 01-01-01
Hex Y1: 1A
Y2: 15

In the logic settings in the preferences, you can set the display format (Bit or Hex), the cursor order (Cursor Order), and the bit order (Bit Order).

▶ See here.

Horizontal and Vertical Cursors (H & V) - T-Y waveforms

Displays the horizontal and vertical cursors simultaneously.

Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.

CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8

1 You can select the channel of an installed module. You cannot select the channel of a logic module.
2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.

Moving the Cursors (V Cursor1/V Cursor2, H Cursor1/H Cursor2)

Use V-Cursor1, V-Cursor2, H-Cursor1, and H-Cursor2 to move the cursors.

Taking the center of the waveform display window to be 0 div, you can move the cursors within the range of −5 to 5 div in steps of the following sizes: for horizontal cursors, 0.01 div; for vertical cursors, Time/div × 10 ÷ display record length.

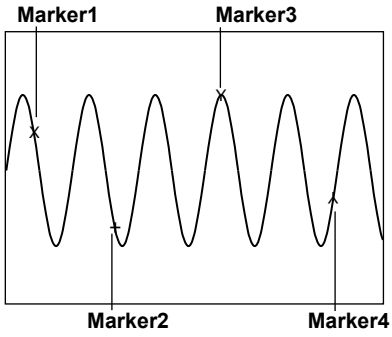
Measurement Items (Item Setup)

You can measure the following horizontal and vertical values at the cursor positions.

Horizontal Axis	
X1	Time value at V-Cursor1
X2	Time value at V-Cursor2
ΔX	Difference between the time values of V-Cursor1 and V-Cursor2
1/ΔX	Reciprocal of the difference between the time values of V-Cursor1 and V-Cursor2
Vertical Axis	
Y1	Vertical value of H-Cursor1
Y2	Vertical value of H-Cursor2
ΔY	Difference between the vertical values of H-Cursor1 and H-Cursor2

Marker Cursors (Marker) - T-Y waveforms

Four markers are displayed on the selected waveform. You can measure the level at each marker, the amount of time from the trigger position to each marker, and the level and time differences between markers.



Markers (Marker1 through 4)

Select the markers, from Marker1 to 4, that you want to display. You can assign each marker to a different waveform.

Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.

- OFF: Disables the marker
- CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8

1 You can select the channel of an installed module. You cannot select the channel of a logic module.

2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.

3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.

Position (Position)

Set the position of the selected marker.

Taking the center of the waveform display window to be 0 div, you can move the markers within the range of −5 to 5 div in steps of the following size: Time/div × 10 ÷ display record length.

Marker Shape (Marker Form)

Set the shape of the displayed marker to one of the options below.

- Mark: A dot
- Line: A crosshair

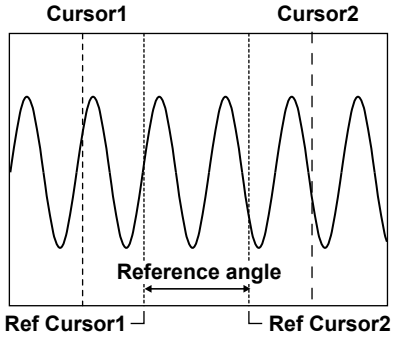
Measurement Items (Item Setup)

Marker cursors move on the waveform data. You can measure the following values at the markers.

X1	Time value at Marker1
X2	Time value at Marker2
X3	Time value at Marker3
X4	Time value at Marker4
Δ(X2-X1)	Difference between the time values of Marker1 and Marker2
Δ(X3-X1)	Difference between the time values of Marker1 and Marker3
Δ(X4-X1)	Difference between the time values of Marker1 and Marker4
Δ(X3-X2)	Difference between the time values of Marker2 and Marker3
Δ(X4-X2)	Difference between the time values of Marker2 and Marker4
Δ(X4-X3)	Difference between the time values of Marker3 and Marker4
Y1	Vertical value at Marker1
Y2	Vertical value at Marker2
Y3	Vertical value at Marker3
Y4	Vertical value at Marker4
Δ(Y2-Y1)	Difference between the vertical values of Marker1 and Marker2
Δ(Y3-Y1)	Difference between the vertical values of Marker1 and Marker3
Δ(Y4-Y1)	Difference between the vertical values of Marker1 and Marker4
Δ(Y3-Y2)	Difference between the vertical values of Marker2 and Marker3
Δ(Y4-Y2)	Difference between the vertical values of Marker2 and Marker4
Δ(Y4-Y3)	Difference between the vertical values of Marker3 and Marker4

Angle Cursors (Degree) - T-Y waveforms

You can measure time values and convert them to angles. On the time axis, set the zero point (Ref Cursor1 position), which will be the measurement reference, the end point (Ref Cursor2 position), and the reference angle that you want to assign to the difference between Ref Cursor1 and Ref Cursor2. Based on this reference angle, you can measure the angle between two angle cursors (Cursor1 and Cursor2).



Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.
CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8, All[4]

1 You can select the channel of an installed module.
2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel.
4 Cursor measurement is performed on all channels.

Moving the Cursors (Cursor1/Cursor2)

Use Cursor1 and Cursor2 to move the cursors.
Taking the center of the waveform display window to be 0 div, you can move the cursors within the range of −5 to 5 div in steps of the following size: Time/div × 10 ÷ display record length.

Reference Angle (Ref Value)

Set the reference angle you want to assign to the range defined by Ref Cursor1 and Ref Cursor2.
Selectable range: 1 to 720

References (Ref1/Ref2)

Set the zero point (Ref Cursor1) and the end point (Ref Cursor2).
Taking the center of the waveform display window to be 0 div, you can move the cursors within the range of −5 to 5 div in steps of the following size: Time/div × 10 ÷ display record length.

Measurement Items (Item Setup)

The DL850/DL850V measures the angle cursor (Cursor1 and Cursor2) positions as angles.

X1	Angle of Cursor1 from Ref Cursor1
X2	Angle of Cursor2 from Ref Cursor1
ΔX	Angle difference between Cursor1 and Cursor2
Y1	Vertical value at the intersection of Cursor1 and the waveform[1]
Y2	Vertical value at the intersection of Cursor2 and the waveform[2]
ΔY	Difference in the vertical values at the points where Cursor1 and Cursor2 intersect the waveforms[2]

1 When Trace is set to All, the values for the channels of all installed modules, the sub channels, and the Math channel are measured.
2 This option does not appear when Trace is set to All.

X-Y Waveforms

Cursor Types (Type)

The following types of X-Y waveform cursors are available.

- OFF: Cursor measurement is not performed.
- Horizontal cursors (Horizontal): Two horizontal cursors are used to measure vertical (Y axis) values.
- Vertical cursors (Vertical): Two vertical cursors are used to measure horizontal (X axis) values.
- Horizontal and vertical cursors (H & V): Two horizontal cursors and two vertical cursors are used to measure vertical (Y axis) and horizontal (X axis) values.
- Marker cursors (Marker): Four marker cursors that move on the waveform are used to measure waveform values.

Horizontal Cursors (Horizontal)

Two dashed lines (horizontal cursors) appear on the horizontal axis. You can measure the vertical (Y axis) value at the position of each horizontal cursor and measure the level difference between the horizontal cursors.

Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.
XY1 to XY8

Moving the Cursors (Cursor1/Cursor2)

Use Cursor1 and Cursor2 to move the cursors.
Taking the center of the waveform display window to be 0 div, you can move the cursors within the range of −5 to 5 div in 0.01 div steps.

Measurement Items (Item Setup)

You can measure the following vertical (Y axis) values at the cursor positions.

Y1	Vertical (Y axis) value at Cursor1
Y2	Vertical (Y axis) value at Cursor2
ΔY	Difference between the vertical (Y axis) values of Cursor1 and Cursor2

Vertical Cursors (Vertical)

Two dashed lines (vertical cursors) appear on the vertical axis. You can measure the horizontal (X axis) value at the position of each vertical cursor and measure the level difference between the vertical cursors.

Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.
XY1 to XY8

Moving the Cursors (Cursor1/Cursor2)

Use Cursor1 and Cursor2 to move the cursors.
Taking the center of the waveform display window to be 0 div, you can move the cursors within the range of −5 to 5 div in 0.01 div steps.

Measurement Items (Item Setup)

You can measure the following horizontal (X axis) values at the cursor positions.

X1	Horizontal (X axis) value at Cursor1
X2	Horizontal (X axis) value at Cursor2
ΔX	Difference between the horizontal (X axis) values of Cursor1 and Cursor2

Horizontal and Vertical Cursors (H & V)

You can display the horizontal and vertical cursors simultaneously and measure vertical (Y axis) and horizontal (X axis) values.

Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.
XY1 to XY8

Moving the Cursors (V Cursor1/V Cursor2, H Cursor1/H Cursor2)

Use V-Cursor1, V-Cursor2, H-Cursor1, and H-Cursor2 to move the cursors.
Taking the center of the waveform display window to be 0 div, you can move the cursors within the range of −5 to 5 div in 0.01 div steps.

Measurement Items (Item Setup)

You can measure the following horizontal (X axis) and vertical (Y axis) values at the cursor positions.

Horizontal Axis (X axis)	
X1	Horizontal (X axis) value at V-Cursor1
X2	Horizontal (X axis) value at V-Cursor2
ΔX	Difference between the horizontal (X axis) values of V-Cursor1 and V-Cursor2
Vertical Axis (Y axis)	
Y1	Vertical (Y axis) value at H-Cursor1
Y2	Vertical (Y axis) value at H-Cursor2
ΔY	Difference between the vertical (Y axis) values of H-Cursor1 and H-Cursor2

Marker Cursors (Marker)

Four markers are displayed on the selected waveform. You can measure the level at each marker, the amount of time from the trigger position to each marker, and the level and time differences between markers.

Markers (Marker1 through 4)

Select the markers, from Marker1 to 4, that you want to display. You can assign each marker to a different waveform.

Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.
XY1 to XY8

Position (Position)

Set the position of the selected marker.
Taking the center of the waveform display window to be 0 div, you can move the markers within the range of −5 to 5 div in steps of the following size: Time/div × 10 ÷ display record length.

Marker Shape (Marker Form)

Set the shape of the displayed marker to one of the options below.

- Mark: A dot
- Line: A crosshair

Measurement Items (Item Setup)

Marker cursors move on the waveform data. You can measure the following values at the markers.

X1	Horizontal (X axis) value at Marker1
X2	Horizontal (X axis) value at Marker2
X3	Horizontal (X axis) value at Marker3
X4	Horizontal (X axis) value at Marker4
Y1	Vertical (Y axis) value at Marker1
Y2	Vertical (Y axis) value at Marker2
Y3	Vertical (Y axis) value at Marker3
Y4	Vertical (Y axis) value at Marker4
T1	Time from the trigger position at Marker1
T2	Time from the trigger position at Marker2
T3	Time from the trigger position at Marker3
T4	Time from the trigger position at Marker4
Δ(T2-T1)	Time difference between Marker1 and Marker2
Δ(T3-T1)	Time difference between Marker1 and Marker3
Δ(T4-T1)	Time difference between Marker1 and Marker4

FFT Waveforms

Cursor Types (Type)

The following types of FFT waveform cursors are available.

- OFF: Cursor measurement is not performed.
- Marker cursors (Marker): You can use four marker cursors to measure frequencies, levels, and the distances between markers.
- Peak cursors (Peak): You can use peak cursors to measure peak frequency and level values.

Marker Cursors (Marker)

You can measure the frequency and level at each marker and the frequency and level differences between markers. You can select a measurement source waveform for each cursor.

Markers (Marker#)

The selected markers appear on the measurement source waveforms.

Measurement Source Waveform (Trace)

Set the measurement source waveform for each marker to one of the waveforms below.

- OFF: Disables measurement.
- FFT1: The waveform in the FFT1 window is measured.
- FFT2: The waveform in the FFT2 window is measured. You can make measurements in the FFT2 window on models equipped with the /G2 option.

Position (Position)

Set the position of the selected marker.
You can move the markers within the range of −5 to 5 div of the frequency axis in 0.01 div steps.

Marker Shape (Marker Form)

Set the shape of the displayed marker to one of the options below.

- Mark: A dot
- Line: A crosshair

Measurement Items (Item Setup)

Marker cursors move on the waveform data. You can measure the following values at the markers.

X1	Frequency at Marker1
X2	Frequency at Marker2
X3	Frequency at Marker3
X4	Frequency at Marker4
Δ(X2-X1)	Frequency difference between Marker1 and Marker2
Δ(X3-X1)	Frequency difference between Marker1 and Marker3
Δ(X4-X1)	Frequency difference between Marker1 and Marker4
Δ(X3-X2)	Frequency difference between Marker2 and Marker3
Δ(X4-X2)	Frequency difference between Marker2 and Marker4
Δ(X4-X3)	Frequency difference between Marker3 and Marker4
Y1	Level at Marker1
Y2	Level at Marker2
Y3	Level at Marker3
Y4	Level at Marker4
Δ(Y2-Y1)	Level difference between Marker1 and Marker2
Δ(Y3-Y1)	Level difference between Marker1 and Marker3
Δ(Y4-Y1)	Level difference between Marker1 and Marker4
Δ(Y3-Y2)	Level difference between Marker2 and Marker3
Δ(Y4-Y2)	Level difference between Marker2 and Marker4
Δ(Y4-Y3)	Level difference between Marker3 and Marker4

Peak Cursors (Peak)

The DL850/DL850V detects the waveform peaks in the range of −5 to 5 div of the frequency axis and measures their frequencies and levels.

Measurement Items (Item Setup)

The following values at the peaks are measured. F2 and Y2 are items that can be measured on models with the /G2 option.

F1	Frequency at Peak1
F2	Frequency at Peak2
Y1	Level at Peak1
Y2	Level at Peak2

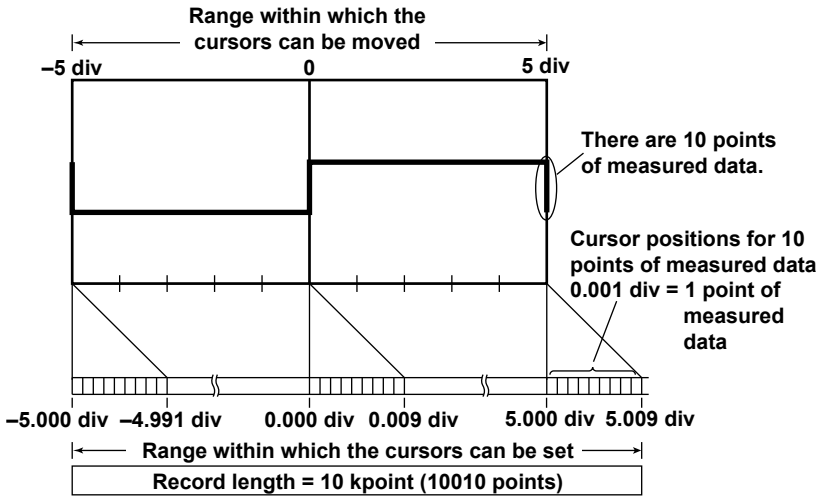
Notes about Cursor Measurement

Cursor Measurement

- You cannot perform cursor measurement on snapshot waveforms or accumulated waveforms that have been acquired in the past. You can perform cursor measurement on the most recent accumulated waveform.
- For history waveforms, cursor measurement is performed on the waveform whose record number is selected.
- The measured time values are based on the trigger position.
- The measured value for data that cannot be measured appears as "***."
- The pulse/rotate setting only affects the X-axis (horizontal) cursor measurement values.
- While the dual capture window is displayed, you can perform cursor measurements on captured waveforms. To perform cursor measurements on the main waveform, on the DUAL CAPTURE menu, turn the display of the dual capture window off (Window: OFF).
- The results of measuring captured waveforms are displayed in italics.

Selectable Range of Cursor Positions

In cursor measurements, measurement is performed on the data stored in the acquisition memory, not on the displayed data. Because 1001 points along the time axis are used to display the waveform, the number of acquired data points is equal to the set record length × 1.001. If the record length is set to 10 kpoint, the number of acquired data points is 10010. Therefore, if the record length is set to 10 kpoint, there will be 10 points of measured data at the same position on the screen. The cursor display position is normally within ±5 div of the center of the waveform display window. In this case, if the cursor display position is set to 5 div from the center of the window, only 1 point out of 10 points can be measured even if there are 10 points of measured data at the same time axis position. For these kinds of situations, the cursor position can be set in the range of −5 div to 5.009 div (if the record length is set to 10 kpoint) from the center of the window. In other words, you can measure the data at the right end of the waveform display window by setting the cursor position to a value in the range of 5.000 to 5.009 div from the center of the window. Because the number of points at the same time axis position increases as the record length gets larger, the range varies depending on the record length (5.000 to 5.0099 div for 100 kpoint).


Range within which the cursors can be moved
–5 div
0
5 div
There are 10 points of measured data.
Cursor positions for 10 points of measured data
0.001 div = 1 point of measured data
–5.000 div
–4.991 div
0.000 div
0.009 div
5.000 div
5.009 div
Range within which the cursors can be set
Record length = 10 kpoint (10010 points)

Notes about Using the 16-CH Voltage Input Module

▶ See here.

10 Automated Measurement of Waveform Parameters

The DL850/DL850V can automatically measure various parameters of the displayed waveform, such as the maximum and minimum values. It can also compute statistics for the automatically measured data.

Mode Settings (Mode)

The following types of statistical processing are available for the automatically measured values of waveform parameters.

- OFF: Automated measurement is not performed.
- Automated measurement of waveform parameters (ON): Automated measurement is performed.
- Normal statistical processing (Statistics): Normal statistical processing is performed.
- Cyclic statistical processing (Cycle Statistics): Statistical processing is performed for each period (cyclic statistical processing).
- Statistical processing of history waveforms (History Statistics): Statistical processing is performed on history waveforms.

Automated Measurement of Waveform Parameters (ON)

The DL850/DL850V automatically measures the specified measurement items on the source waveform.

Measurement Items (Measure Setup)

Measurement Source Waveform (Trace)

Set the measurement source waveform to one of the waveforms below.
CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8, XY1 to XY8

1 You can select the channel of an installed module. You cannot select the channel of a logic module.
2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.

Measurement Item (Item)

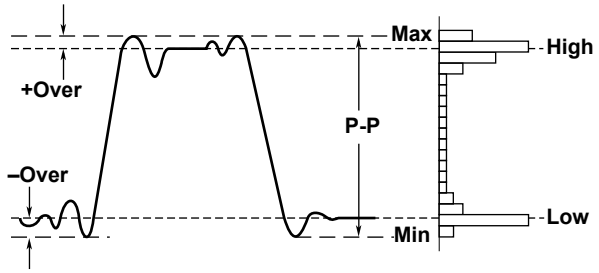
You can choose from the 28 measurement items and delay measurement items listed below. The DL850/DL850V can store a total of up to 64000 data values for all waveforms (CH1 through CH16, 16chVOLT, CAN, and Math1 to Math8). A total of up to 32 measurement items can be displayed on the screen.

- **Voltage Measurement Items**

Peak to Peak(P-P)	P-P value (Max − Min) [V]
Amplitude(Amp)	Amplitude (High − Low) [V]
Maximum(Max)	Maximum voltage [V]
Minimum(Min)	Minimum voltage [V]
High	High voltage [V]
Low	Low voltage [V]
Average(Avg)	Average voltage ((1/n)Σxi) [V]
Middle(Mid)	(Max + Min)/2 [V]
RMS[1]	Rms voltage $((1/(\sqrt{n}))(\Sigma(xN^2))^{1/2})$ [V]
Std.Deviation(SDev)	Standard deviation $(1/n(\Sigma xi^2 - (\Sigma xi)^2/n)^{1/2})$ [V]
+Overshoot(+Over)	Overshoot ((Max − High)/(High − Low) × 100) [%]
−Overshoot(−Over)	Undershoot ((Low − Min)/(High − Low) × 100) [%]

1 On a channel that has been set to power spectrum computation (PS or PSD), if RMS is set to ON, “Rms = overall value” appears on the screen.

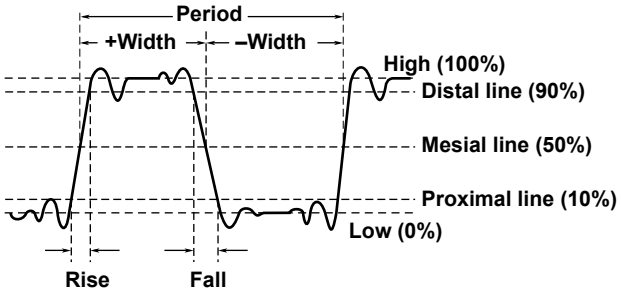
* The names in parentheses are the measurement item names that appear when the measured values are displayed.



- **Time Measurement Items**

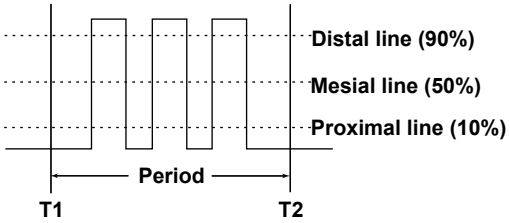
Rise	Rise time [s]
Fall	Fall time [s]
Frequency(Freq)	Frequency [Hz]
Period	Period [s]
+Width	Time width of the portion that is greater than the mesial value [s]
−Width	Time width of the portion that is less than the mesial value [s]
Duty	Duty cycle (+Width/Period × 100) [%]
Avg.Frequency(Avg.F)	Average frequency in the measurement time period [Hz]
Avg.Period(Avg.P)	Average period in the measurement time period [s]

* The names in parentheses are the measurement item names that appear when the measured values are displayed.

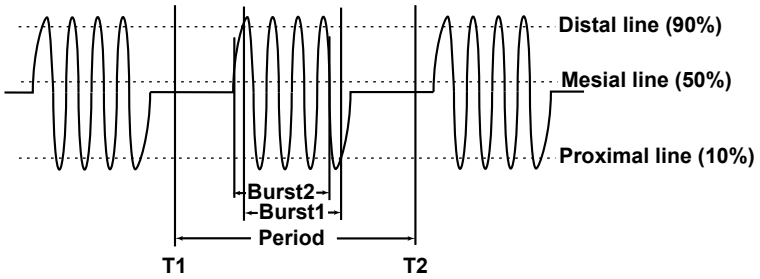


Pulse	Pulse count Set the measurement time period (Time Range) to a value appropriate for the pulse that you want to measure.

When Pulse = 3



Burst1 and Burst2	Burst period [s] Set the measurement time period (Time Range) to a value appropriate for the burst period that you want to measure.



- **Other Measurement Items**

When Trace Is Set to CH, Sub Channel, or Math	
Integ1TY(Integ1)	Area of the positive amplitude
Integ2TY(Integ2)	Area of the positive amplitude − area of the negative amplitude
When Trace Is Set to XY	
Integ1XY(Integ1)	Total triangular area of the X-Y waveform
Integ2XY(Integ2)	Total trapezoidal area of the X-Y waveform

* The names in parentheses are the measurement item names that appear when the measured values are displayed.

For detailed information about how the area of the X-Y waveform is computed, see Appendix 1, “How Waveform Areas Are Calculated.”

▶ See here.

All Clear (All Clear)

You can turn off all the items for the waveform selected for Trace at once.

Copy (Copy to)

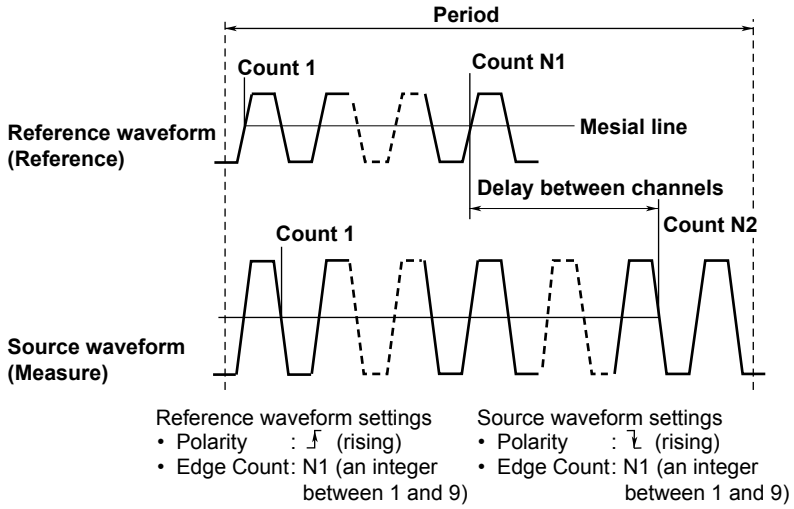
You can copy the settings of the waveform selected for Trace to other traces.

- You can turn the following channels on and off separately: CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8.
  1 You can select the channel of an installed module. You cannot select the channel of a logic module.
  2 If the 16-CH Voltage Input Module is installed. Select individual sub channels from the ones displayed.
  3 On the DL850V when a CAN bus monitor module is installed. Select individual sub channels from the ones displayed. If the data type (Value Type) is set to Logic, you will not be able to select it.
- All ON: All traces are turned on.
- All OFF: All traces are turned off.
- Execute: Select Execute to copy the settings.

When Trace is set to XY, All Clear and Copy to are not available.

Setting the Delay (Delay Setup)

The time difference between traces or the time difference from the trigger point to a rising or falling edge is called the delay between channels.



- **Mode**

  Select a delay measurement mode.
  - OFF: Delay measurement is not performed.
  - Time: The delay between channels is displayed as a time.
  - Degree: The delay between channels is displayed as an angle.

- **Polarity**

  Select the slope of the edge you want to detect.
  - : Rising
  - : Falling

- **Edge Count**

  Sets which edge counted from the start point (T Range1) of the measurement time period to use as a detected point (measured point).
  Selectable range: 1 to 9

- **Reference**

  Select whether to use a trace or trigger as the reference for the reference waveform.
  - Trace: A trace is used.
  - Trigger: A trigger is used.

- **Reference Waveform (Reference Trace)**

  When Reference is set to Trace, set the reference waveform.
  - Trace: Select a reference waveform. CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math8

    1 You can select the channel of an installed module. You cannot select the channel of a logic module.

    2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.

    3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.
  - Polarity: Select the slope of the edge you want to detect (: rising, : falling).
  - Edge Count: Sets which edge counted from the start point (T Range1) of the measurement time period to use as a detected point (reference point). Selectable range: 1 to 9

- The voltage level of the detected point is the mesial line.
- The measurement item name that appears when the measured values are displayed is (Delay).
- If Mode is set to Degree and Reference is set to Trigger, the measured value is displayed as '*****'.

Detail Parameter (Detail Parameter)

Set the reference level that is used to measure various parameter values, such as the rise and fall times, for each measurement source waveform.

- **Distal, Mesial, and Proximal Unit Setting (Mode)**

  Set the method for setting the three levels that are used as references in the measurement of various parameter values, such as the rise and fall times.
  - %

    You can set the distal, mesial, and proximal values as percentages of the specified trace (CH1 to CH16, 16chVOLT, CAN, or Math1 to Math8). The high value of the specified trace is equal to 100%, and the low value is equal to 0%.
  - Unit

    You can set the distal, mesial, and proximal values of the specified trace (CH1 to CH16, 16chVOLT, CAN, or Math1 to Math8) by specifying physical values, such as voltages or temperatures.

- **Distal, Mesial, and Proximal Settings (Distal, Mesial, Proximal)**

  You can set the distal, mesial, and proximal values.
  - Selectable range: 0.0 to 100.0% (in 0.1% steps) or voltage or temperature values that correspond to ± 10 div (the steps that you can set voltage and temperature values in vary depending on the module. See Range of V/div).

- **High/Low Specification Method (High/Low)**

  The high and low levels are the 100% and 0% levels used to measure various parameter values, such as the rise and fall times. You can choose one of the following methods for setting the high and low levels.
  - Auto

    The DL850/DL850V sets the high value to the high amplitude level and the low value to the low amplitude level based on the voltage level frequency of the waveform in the measurement time period while taking into account the effects of ringing, spikes, etc. This method is suitable for measuring square waves and pulse waves.
  - Max-Min

    The DL850/DL850V sets the high and low values to the maximum and minimum values in the measurement time period. This method is suitable for measuring sinusoidal and saw waves. It is not suitable for waveforms that have ringing and spikes.

Measurement Time Period (Time Range1/Time Range2)

Set the measurement time period using two vertical cursors. The position of the thin dashed line (Time Range1) is the measurement start point. The position of the thick dashed line (Time Range2) is the measurement end point. The number of data points in the measured waveform can be up to 100 Mpoint from the measurement start point.

The measurement time period is similar to the selectable range of the cursor display position in cursor measurement.

For details, see "Selectable Range of Cursor Positions."

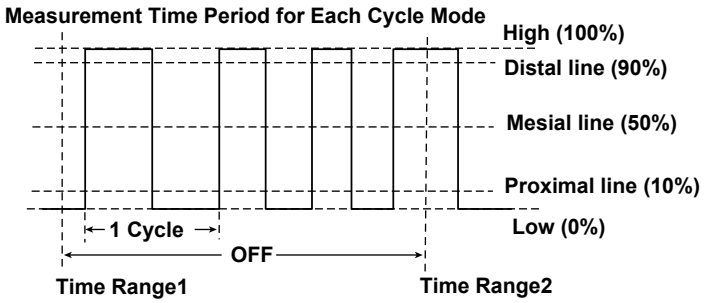
▶ See here.

1-Cycle Mode (1-Cycle Mode)

Instead of automatically measuring the measurement time period specified by Time Range1 and Time Range2, you can automatically measure the first period after Time Range1.
The method of determining the period is the same as the method for determining the Period measurement item.

In this mode, after the period is determined, the values of the measurement items related to voltage and area are computed. This mode is effective for measurement items, such as Rms or Avg, that may result in errors depending on the measurement time period setting.
The measurements of time axis items and X-Y areas are not affected.

- OFF: 1-cycle mode is disabled.
- ON: 1-cycle mode is enabled.



If the space between Time Range1 and Time Range2 is less than one period, "*****" is displayed for the measured value.

Notes about Automated Measurement of Waveform Parameters

- Measurements cannot be made on a snapshot waveform or an accumulated waveform that is not the most recent waveform.
- When an item is impossible to measure (its measurement time period is greater than 100 Mpoint), its measured value is displayed as '*****'.
- The DL850/DL850V may not measure correctly if the waveform amplitude is small.
- If there are two or more waveform periods within the measurement time period, the time-axis parameters are measured on the first period.
- Logic waveforms cannot be automatically measured.
- When automated measurement is performed on a waveform that has been recorded to a hard disk, extra time will be required for hard disk access.
- Automated measurement may require additional time depending on settings such as the memory length, the number of measurement items, and the input waveform. During automated measurement, appears in the center of the screen.
- To cancel automated measurement, set Mode to OFF. Measurement stops immediately.
- Only the Max and Min items can be measured for FFT waveforms. Only the overall rms power spectrum value can be measured.
- While the dual capture window is displayed, you can perform automated measurements of waveform parameters on captured waveforms.
  To perform automated measurement of the waveform parameters in the main window, turn the display of the dual capture window off.
- The automated measurement results of captured waveforms are displayed in italics.

Normal Statistical Processing (Statistics)

While acquiring waveforms, the DL850/DL850V calculates the statistics of the waveforms that it has acquired so far. If you stop waveform acquisition and then restart it, the DL850/DL850V will continue statistical processing and include the data from before waveform acquisition was stopped. The DL850/DL850V also performs statistical processing for selected automatically measured items that are not displayed. The number of measured values used to calculate statistics (Count) is equal to the number of waveforms that have been acquired up to that point.

If you add an additional automatically measured item to apply statistical processing to, the number of measured values used to calculate the statistics (Cnt) is reset to 1 regardless of whether the DL850/DL850V is acquiring waveforms.

Measurement Items (Measure Setup)

Statistical processing is performed on the same measurement items that the automated measurement of waveform parameters is performed on. The following five statistics are computed for the measurement items whose measurement has been turned on. The maximum number of measurement items that can be displayed on the screen is 3.

- Maximum: Maximum value
- Minimum: Minimum value
- Average: Average value
- SDev: Standard deviation
- Count: Number of measured values used to calculate statistics

The measurement items are the same as those for the automated measurement of waveform parameters.

▶ See here.

If you select CH1 P-P as the automatically measured item, the number of measured values used to calculate the maximum, minimum, mean, and standard deviation values for CH1 P-P appear at the bottom of the screen.

The DL850/DL850V can display the statistical results of three automatically measured items. If four or more automatically measured items are selected, the DL850/DL850V displays the first three items ordered by ascending channel number and the order that the items appear in the Item Setup automated-measurement-item selection menu (P-P, Amp, Max, Min, ..., Init1XY, and Init2XY).

Example 1:

When CH1: P-P, Amp; CH2: Min; CH3: Max, Min are selected, the following items are displayed: CH1: P-P; CH2: Min; CH3:Max.

Example 2:

When CH1: Max, Min; CH2: P-P, Amp are selected, the following items are displayed: CH1: Max, Min; CH2: P-P.

You can view the statistics of other items in the following way.

- Load the items into a PC using the communication feature.
- Save the statistical items as automated measurement values of waveform parameters, and load the data into a PC.
- Scroll through the list of calculated statistics using the arrow keys.

Measurement Time Period (Time Range1/Time Range2)

This setting is the same as the measurement time period setting for the automated measurement of waveform parameters.

▶ See here.

1-Cycle Mode (1-Cycle Mode)

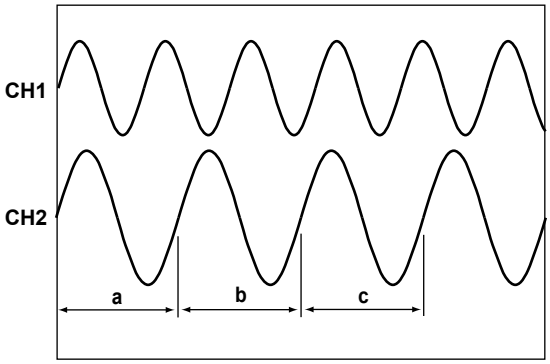
This setting is the same as the 1-cycle mode setting for the automated measurement of waveform parameters.

▶ See here.

Cyclic Statistical Processing (Cycle Statistics)

The DL850/DL850V determines periods in order from the oldest data of the displayed waveform, measures the selected automatically measured items within each period, and performs statistical processing on the results of automated measurement. The method used to determine the period in cyclic statistical processing is the same as the method used to determine the Period waveform parameter. You can choose whether to determine the period for the selected waveform and use it on all source waveforms or to determine individual periods for each waveform.

Example in Which Cycle Trace Is Set to CH2



Measures the items in ranges a, b, and c, and calculates statistics on the items in the order a, b, and c.
The items of other channels are also measured in ranges a, b, and c.
If you select Own, the items are measured over each waveform's period.

Measurement Items (Measure Setup)

These items are the same as those for the normal statistical processing of automated measurement parameters.

▶ See here.

The following items are not measured:

- For waveforms that are used in period determination
  Avg.Frequency, Avg.Period, Pulse (pulse count), Integ1XY (area), Integ2XY (area), Delay
- For other waveforms
  Integ1XY (area), Integ2XY (area), Delay

Measurement Time Period (Time Range1/Time Range2)

This setting is the same as the measurement time period setting for the automated measurement of waveform parameters.

▶ See here.

Cycle Trace (Cycle Trace)

Selects the source waveform used to determine the period.

- **CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math to Math8**

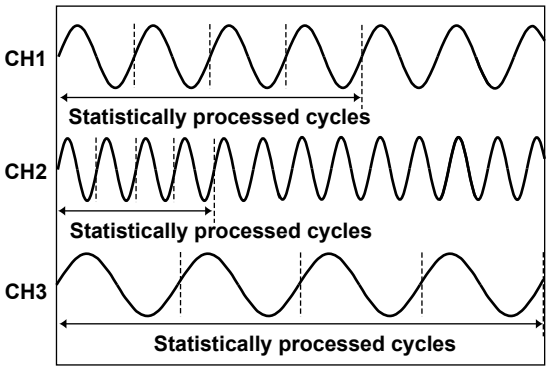
  The period of the specified waveform is applied to all waveforms.

  1 You can select the channel of an installed module. You cannot select the channel of a logic module.
  2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
  3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.

- **Own**

  A period is determined for each source waveform. However, if signals that have different periods are applied to multiple channels, the number of iterations of automated measurement and statistical processing for each signal is equal to the number of periods in the slowest signal.

When Cycle Trace Is Set to Own



The number of cycles in the channel with the slowest cycle (CH3) is four, so statistical processing is performed on the four oldest cycles of the data for CH1 and CH2. The remaining data is not used for statistical processing.

Statistical processing is performed in periods that are determined in order from the oldest data of the displayed waveform. It cannot be used at the same time as 1-cycle mode.

Execution of Measurement (Execute Measure)

Executes statistical processing. You can select Execute Measure when Mode is set to Cycle Statistics or History Statistics.

Press Abort to stop statistical processing.

- The number of cycles being used for the cyclic statistical processing is displayed in the statistical display's Count column.
- The number of cycles that can be used in cyclic statistical processing varies depending on the number of measured items that the DL850/DL850V is calculating the statistics of.
  64000/(the number of measured items that the DL850/DL850V is calculating the statistics of)

Result Display (Display Result)

Displays a list of calculated statistics. You can display the list of statistics when Mode is set to Cycle Statistics or History Statistics.
Numbers are assigned to the data in order from the oldest cycle data or history data, and the automated measurement results for each number are displayed.
The maximum and minimum values for each parameter are indicated on the list by ↑ (maximum value) and ↓ (minimum value). If the same value appears in multiple locations, the oldest occurrence of the value is marked as the maximum or minimum value.
The number of data points that can be listed is 64000. If the number of data points exceeds 64000, the most recent data points in the history waveform or automatically measured item data are displayed. If the number of data points exceeds 64000, the maximum and minimum values may be outside of range of the displayed list. When this happens, ↑ (maximum value) and ↓ (minimum value) will not appear.

- **Sort**

  Sorts the list in the specified order.
  Forward (from the oldest) or Reverse (from the latest)

- **Statistics Max**

  Moves to the maximum value (↑) for the selected measurement item.

- **Statistics Min**

  Moves to the minimum value (↓) for the selected measurement item.

In cyclic statistical processing, you can select a waveform number (one period) with the jog shuttle and press the SET key to zoom in on it. Statistical processing is only performed on the number of data points that can be displayed in the list.

Statistical Processing of History Waveforms (History Statistics)

In the statistical processing of history waveforms, the DL850/DL850V measures automatically measured items on the acquired waveform using the history feature and performs statistical processing on them. Statistical processing is performed on older waveform data first. The waveforms that statistical processing is performed on are those waveforms shown in the List that can be accessed from the HISTORY menu. Statistical processing of history waveforms can be used with 1-cycle mode and the delay feature.

Measurement Items (Measure Setup)

These items are the same as those for the normal statistical processing of automated measurement parameters.
▶ See here.

Measurement Time Period (Time Range1/Time Range2)

This setting is the same as the measurement time period setting for the automated measurement of waveform parameters.
▶ See here.

Execution of Measurement (Execute Measure)

This item is the same as the Execute Measure item for cyclic statistical processing.
▶ See here.

- In the statistical processing of history waveforms, the number of history waveforms that processing is performed on is indicated in the Count column of the statistical value display.
- The number of history waveforms that can be used in the statistical processing of history waveforms varies depending on the number of measured items that the DL850/DL850V is calculating the statistics of.
  64000/(the number of measured items that the DL850/DL850V is calculating the statistics of)

Result Display (Display Result)

This item is the same as the Display Result item for cyclic statistical processing.

▶ See here.

In the statistical processing of history waveforms, you can select a waveform with the jog shuttle and press the SET key to zoom in on it.

Notes about Statistical Processing

- During statistical processing, appears in the center of the screen. All soft keys except for Abort are invalid.
- Statistical processing cannot be performed:
  - On waveforms that have been recorded to a hard disk.
  - On FFT waveforms.
  - When the measurement time period is greater than 100 Mpoint.
- The starting and stopping of statistical processing may require additional time depending on settings such as the record length, the number of statistical processing items, and the input waveform.
- While the dual capture window is displayed, you can perform statistical processing on captured waveforms. To perform statistical processing on the waveforms in the main window, turn the display of the dual capture window off.
- The automated measurement results of captured waveforms are displayed in italics.

Notes about Using the 16-CH Voltage Input Module

▶ See here.

11 Computation

You can perform various computations on up to 1 Mpoint of data. (When more than 1 Mpoint of waveform data is displayed, computation is performed on the first 1 Mpoint of data from the computation start point.)
The results of computation are displayed in Math1 to Math8. Waveforms stored through hard disk recording cannot be computed.

Turning Computation On and Off (Mode)

Select whether to use computation.

- ON: Computation is used.
- OFF: Computation is not used.

Computation Waveform Selection (Select Math Trace)

Select a computed waveform to use to display the computation results.
Math1 to Math8

Computation Settings (Math Setup)

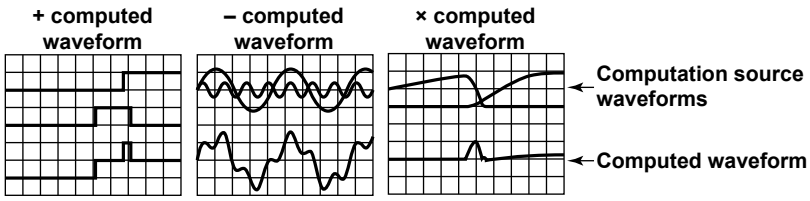
Operator (Operation)

Select an operator (type of computation) from the options below.

- OFF: Computation is not performed.
- S1+S2: Adds the waveforms assigned to Source1 and Source2
- S1−S2: Subtracts the waveform assigned to Source2 from the waveform assigned to Source1
- S1*S2: Multiplies the waveforms assigned to Source1 and Source2
- S1/S2: Divides the waveform assigned to Source1 by waveform assigned to Source2
- Bin(S1): Converts the waveform assigned to Source to binary
- PS(S1): Computes the power spectrum of the waveform assigned to Source
- Shift(S1): Shows the waveform assigned to Source with its phase shifted
- User Define: Performs user-defined computation (/G2 option).

Basic Arithmetic (S1+S2, S1−S2, S1*S2, and S1/S2)

Performs addition, subtraction, multiplication, or division on the two waveforms assigned to Source1 and Source2.



Computation Source Waveforms (Source or Source1 and Source2)

CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math7[4]

1 You can select the channel of an installed module. You cannot select the channel of a logic module.
2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.
4 You can use other computed waveforms as computation source waveforms. If the waveform that you are configuring is MathX, you can use a computation waveform up to MathX − 1 as the computation source waveform. You cannot use another computation waveform as the computation source waveform for Math1.

When computation is performed on a linearly scaled channel, the scaled values are used.

Unit (Unit)

You can assign a unit of up to four characters in length to the computed results. The specified unit is reflected in the scale values.

Label (Label)

You can create a label of up to eight characters in length. The labels that you create are displayed on the screen.

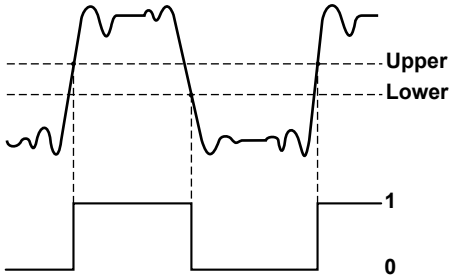
Turning the Display On and Off (Display)

Select whether to display the computed waveform.

- ON: Displays the computed waveform
- OFF: Does not display the computed waveform

Binary Conversion (Bin (S1))

Using the specified threshold levels, you can convert the waveform assigned to Source to a digital waveform.



Computation Source Waveform (Source), Unit (Unit), Label (Label), and Turning the Display On and Off (Display)

These settings are the same as those for basic arithmetic.

▶ See here.

Upper and Lower Thresholds (Thr. Upper/Thr. Lower)

Set the upper and lower threshold values. All values above the upper threshold on the computation source waveform are converted to ones, and all values below the threshold are converted to zeros.

Power Spectrum (PS (S1))

Performs an FFT (fast Fourier transform) on the waveform assigned to Source, and displays a power spectrum. You can use this function to view the frequency distribution of an input signal.

Computation Source Waveform (Source), Unit (Unit), Label (Label), and Turning the Display On and Off (Display)

These settings are the same as those for basic arithmetic.

▶ See here.

FFT Settings (FFT Setup)

Select the data points and window function to use for the FFT.

- **Number of FFT Points (FFT Points)**

  You can set the number of points from the start of computation on the T-Y waveform to one of the options below.

  1k, 2k, 5k, 10k, 20k, 50k, or 100k

- **Window Function (Window)**

  You can select the window function from the following options.

  Rect, Hanning, Flat Top, Hamming

  ▶ See here.

Phase Shift (Shift (S1))

You can shift the phase of the waveform assigned to Source, display the resulting waveform, and use the phase-shifted data in computations.

Computation Source Waveform (Source), Unit (Unit), Label (Label), and Turning the Display On and Off (Display)

These settings are the same as those for basic arithmetic.

▶ See here.

Shift (Shift)

You can shift waveforms within the following ranges.

- **When an Internal Clock Is Being Used as the Time Base**

  Selectable range: The time values between −(record length/2) points to (record length/2 points)

  Step: 1 ÷ sample rate

  The sample rate varies depending on how the record length and Time/div settings are configured. For details, see appendix 1, “Relationship between the Time Axis Setting, Record Length, and Sample Rate” in the *Getting Started Guide*, IM DL850-03EN.

- **When an External Clock Is Being Used as the Time Base**

  Selectable range: −(record length/2) points to (record length/2 points)

  Step: 1

Scaling Mode (Scaling Mode)

Set the method used to set the vertical display range of computed waveforms to one of the following options.

- Auto: The upper and lower limits are set automatically.
- Manual: The upper and lower limits must be set manually.

Upper and Lower Limits (Upper/Lower)

Set the upper and lower limits when Scaling Mode is set to Manual.

The selectable range is −9.9999E+30 to 9.9999E+30.

Start Point and End Point (Start Point and End Point)

Set the range of computation by specifying a computation start and end point. The default settings are −5 div and +5 div.

The maximum range from the computation start point to the computation end point varies as indicated below depending on the number of computations.

- One computation: Up to 1 Mpoint
- Two computations: Up to 500 kpoint
- Three or four computations: Up to 250 kpoint
- Five to eight computations: Up to 125 kpoint

The computation range points are similar to the settable range of the cursor display position in cursor measurement.

For details, see “Selectable Range of Cursor Positions.”

▶ See here.

An icon ( ) appears in the center of the top of the screen when computations are being executed.

User-Defined Computation (Optional)

You can perform user-defined computation on models with the /G2 option.

Operator (Operation)

Select User Define.

Expression (Expression) - user-defined

Create an expression by combining computation source waveforms, variables, constants, functions, and operators.

Computation Source Waveforms and Variables

You can use the following waveforms and variables.

Menu Item	Description
C1 to C16	Waveforms from CH1 to CH16
Cn_1 to Cn_16	The waveforms of sub channels 1 to 16 on a 16-CH Voltage Input Module n = 1, 3, 5, 7, 9, 11, 13, 15
Cn_1 to Cn_16	The waveforms of sub channels 1 to 16 on a CAN Bus Monitor Module (You can configure up to 60 sub channels on modules whose firmware version is 1.2 or later.) n = 13 to 16 If the data type (Value Type) is set to Logic, you will not be able to select it.
M1 to M7	Math waveforms
T	Total number of data points in the time direction

When computation is performed on a linearly scaled channel, the scaled values are used.

Operators and Functions

You can use the following operators and functions.

Menu Item	Example	Description
+, −, *, /	C1+C2	Displays the result of performing basic arithmetic on two specified waveforms
SHIFT	SHIFT(C1)	Displays the result of shifting the specified waveform's phase
ABS	ABS(M1)	Displays the absolute values of the specified waveform
SQRT	SQRT(C2)	Displays the square root of the specified waveform
LOG	LOG(C1)	Displays the log of the specified waveform
EXP	EXP(C1)	Displays the exponent of the specified waveform
NEG	NEG(C1)	Displays the specified waveform inverted around 0
SIN	SIN(T)	Displays the sine of the specified waveform
COS	COS(C1)	Displays the cosine of the specified waveform
TAN	TAN(C1)	Displays the tangent of the specified waveform
ATAN	ATAN(C1, C2)	Displays the arc tangent of the two specified waveforms (a value within ±π)
PH	PH(C1, C2)	Displays the phase difference between the two specified waveforms
DIF	DIF(C1)	Displays the derivative of the specified waveform
DDIF	DDIF(C1)	Displays the 2nd order derivative of the specified waveform
INTG	INTG(C1)	Displays the integral of the specified waveform
IINTEG	IINTEG(C1)	Displays the double integral of the specified waveform
BIN	BIN(C1, Up, Lo)	Displays the result of converting specified waveform to binary[1]
P2	P2(C1)	Displays the square of the specified waveform
P3	P3(C1)	Displays the cube of the specified waveform
F1	F1(C1, C2)	Displays the result of computing $\sqrt{\lvert C1^2+C2^2 \rvert}$ for the specified waveforms
F2	F2(C1, C2)	Displays the result of computing $\sqrt{\lvert C1^2-C2^2 \rvert}$ for the specified waveforms
FV	FV(C1)	Displays the inverse of the PWHH of the pulse width
PWHH	PWHH(M1, Up, Lo)	Displays the computation of the pulse widths between a rising edge and the next rising edge[1]
PWHL	PWHL(C2, Up, Lo)	Displays the computation of the pulses width between a rising edge and the next falling edge[1]
PWLH	PWLH(C1, Up, Lo)	Displays the computation of the pulse widths between a falling edge and the next rising edge[1]
PWLL	PWLL(C1, Up, Lo)	Displays the computation of the pulse widths between a falling edge and the next falling edge[1]
PWXX	PWXX(C2, Up, Lo)	Displays the computation of the pulse widths from a rising or falling edge to the next rising or falling edge[1]
DUTYH	DUTYH(C1, Up, Lo)	Positive (high) duty cycle within each cycle of the specified waveform[1]
DUTYL	DUTYL(C1, Up, Lo)	Negative (low) duty cycle within each cycle of the specified waveform[1]
FILT1	FILT1(C1)	Displays the result of applying a filter to the specified waveform
FILT2	FILT2(C1)	Displays the result of applying a filter to the specified waveform
HLBT	HLBT(C1)	Displays the Hilbert transform of the specified waveform
MEAN	MEAN(C1)	Displays the 10th-order moving average of the specified waveform
LS-	LS-MAG(C1)	Displays the amplitude of the specified waveform's linear spectrum
	LS-LOGMAG(C1)	Displays the logarithmic amplitude of the specified waveform's linear spectrum
	LS-PHASE(C1)	Displays the phase of the specified waveform's linear spectrum
	LS-REAL(C1)	Displays the real part of the specified waveform's linear spectrum
	LS-IMAG(C1)	Displays the imaginary part of the specified waveform's linear spectrum
PS-	PS-MAG(C1)	Displays the amplitude of the specified waveform's power spectrum
	PS-LOGMAG(C1)	Displays the logarithmic amplitude of the specified waveform's power spectrum
PSD-	PSD-MAG(C1)	Displays the amplitude of the specified waveform's power spectrum density
	PSD-LOGMAG(C1)	Displays the logarithmic amplitude of the specified waveform's power spectrum density
CS-	CS-MAG(C1, C2)	Displays the amplitude of the cross spectrum of the two specified waveforms
	CS-LOGMAG(C1, C2)	Displays the logarithmic amplitude of the cross spectrum of the two specified waveforms
	CS-PHASE(C1, C2)	Displays the phase of the cross spectrum of the two specified waveforms
	CS-REAL(C1, C2)	Displays the real part of the cross spectrum of the two specified waveforms
	CS-IMAG(C1, C2)	Displays the imaginary part of the cross spectrum of the two specified waveforms
TF-	TF-MAG(C1, C2)	Displays the amplitude of the transfer function of the two specified waveforms
	TF-LOGMAG(C1, C2)	Displays the logarithmic amplitude of the transfer function of the two specified waveforms
	TF-PHASE(C1, C2)	Displays the phase of the transfer function of the two specified waveforms
	TF-REAL(C1, C2)	Displays the real part of the transfer function of the two specified waveforms
	TF-IMAG(C1, C2)	Displays the imaginary part of the transfer function of the two specified waveforms
CH-	CH-MAG(C1, C2)	Displays the amplitude of the coherence function of the two specified waveforms

1 Set the source waveform and the upper and lower threshold levels (Up and Lo).

Constants

Menu Item	Description
K1 to K8	▶ See here.
0 to 9	−
Exp	E notation. Selectable range: −30 to +30 Use this constant to enter values in E notation (1E+3 = 1000, 2.5E−3 = 0.0025). It is displayed as “E” in expressions to distinguish it from the “EXP” operator.

Automated Measurement Values of Waveform Parameters (Measure)

You can use the automated measurement values of waveform parameters in expressions. The DL850/DL850V cannot retrieve waveform parameter values when the display of the measurement source waveform is off.

Combinations of Operators That Are Not Allowed

- An expression cannot be used in another expression with a smaller number.
  Example: Math5 = M6 + M3
- Expressions containing only constants (K1 to K8) are not allowed.
  Example: Math5 = K1 + K8
- An expression can only contain up to two FILT1 or FILT2 functions.
  Example: FILT1(C1)+FILT1(C2)+FILT1(C3)
- A single FFT expression can only contain one operator.
  Example: PS−MAG(C1+C2)
- Additional computations cannot be performed on FFT results.
  Example: PS−MAG(C1)+C2
- Additional computations cannot be performed on pulse width computations.
  Example: PWHH(C1)+C2
- Only one operator can be used in a single phase-shift computation, pulse-width computation, or binary-conversion expression.
  Example: SHIFT(C1+C2), BIN(C1−C2), PWHH(C1*C1)

If you want to perform an FFT, phase-shift, pulse-width, or binary-conversion computation on the computed results of an expression such as C1+C2, create expressions like these: M1=C1+C2, M2=PS−MAG(M1).

Unit (Unit), Label (Label), and Turning the Display On and Off (Display)

These settings are the same as those for basic arithmetic.

▶ See here.

Scaling Mode (Scaling Mode), Upper and Lower Limits (Upper/Lower), and Start and End Points (Start Point/End Point)

▶ See here.

Averaging Settings (Average Setup) - user-defined

You can average and compute the peak values of the results of user-defined computation.

Averaging Modes (Average Mode)

The following types of averaging are available.

- OFF: Averaging is not performed.
- Linear averaging (Linear): Values are averaged linearly.
- Exponential averaging (Exp): Values are averaged exponentially.
- Cycle averaging (Cycle): Values are averaged across cycles.
- Peak computation (Peak): Peak values are computed.

Linear Averaging (Linear)

The number of values specified by the average count are added and divided by the average count, and the resulting values are used to display the waveform. For the equation, see the equation for linear averaging in Averaging Mode.

- **Average Domain (Average Domain)**

  Select what to average.
  - Time: A time-domain waveform is averaged.
  - Freq: A frequency-domain waveform is averaged.

- **Linear Count (Linear Count)**

  Set the average count.
  Selectable range: 2 to 128 in 2^n steps

Exponential Averaging (Exp)

Using the specified attenuation constant, the DL850/DL850V attenuates the influence of previous computed data to produce averaged values, and uses the results to display the waveform. For the equation, see the equation for exponential averaging in Averaging Mode.

- **Average Domain (Average Domain)**

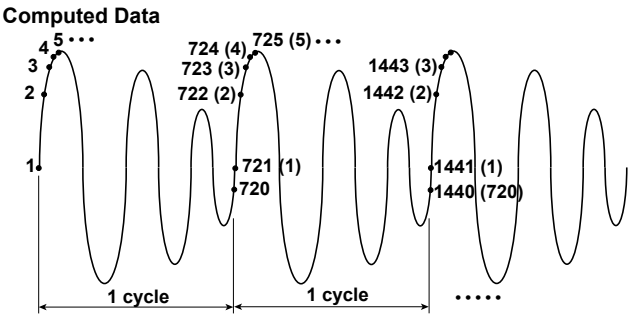
  ▶ See here.

- **Attenuation Constant (Average Weight)**

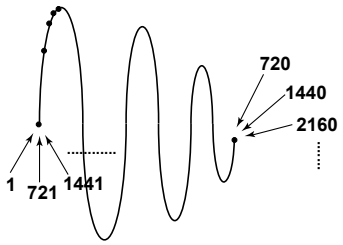
  Set the attenuation constant.
  Selectable range: 2 to 256 in 2^n steps

Cycle Averaging (Cycle)

The data from the computation start point to the computation end point is divided into the number of data points (Cycle Count) that is specified as being a single cycle, and equivalent points in each divided cycle are averaged with each other. The resulting values are used to display the waveform.
The figure below shows the results of cycle averaging when Cycle Count is set to 720.



Cycle Averaging Results
Equivalent points in each divided cycle are linearly averaged, and the resulting values are used to display the waveform.



- **Cycle Count (Cycle Count)**

  Set the number of data points in one cycle.
  Selectable range: 10 to 1800

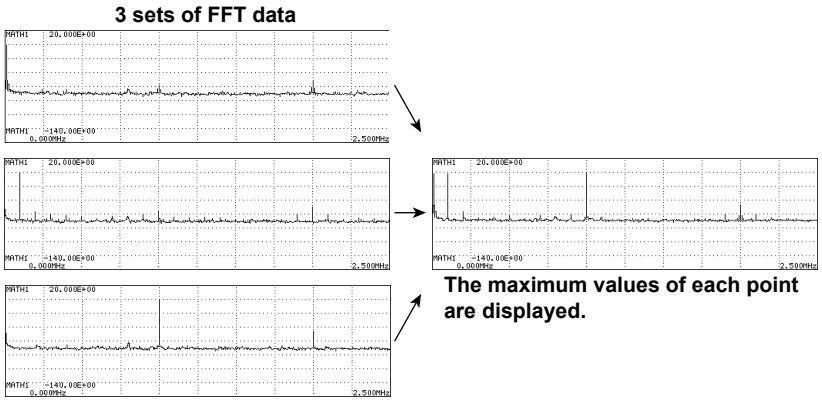
- All the data between the computation start and end points can be computed. If the data cannot be divided evenly by the specified cycle count, the remaining data is ignored.
- Cycle averaging cannot be performed on an FFT waveform.

- **Cycle Averaging Example**

  When the record length is 10 kpoint, the cycle count is 720, the computation start point is −5.000 div, and the computation end point is +5.000 div
  10 k/720 = 13.88... : 13 cycles are used for the computation.
  13×720 = 9360 : The data from the computation start point (point 1) to point 9360 is included in the cycle average computation.

Peak Computation (Peak)

The maximum value at each point of the computed data is determined, and the resulting values are used to display the waveform. For each computation, the new computed value is compared with the past value, and the larger value is kept.



- The DL850/DL850V normally performs scaling by using the computed data at the beginning (auto scaling). For coherence functions and in other cases where the amplitude of the averaged waveform changes significantly, use manual scaling.
- When you execute averaging, after measurement is stopped, computation cannot be restarted. However, computation can be restarted if the number of data points for cycle averaging is changed.
- If you measure an averaged waveform with auto scaling enabled, you cannot change the scaling by switching to manual scaling after measurement has stopped. Changes to the scaling settings are applied to the next measurement.
- In user-defined computation, averaging cannot be performed on pulse width computation.
- If you change the computation conditions during averaging, the computed data up to that point is deleted, and averaging starts over.

FFT Settings (FFT Setup) - user-defined

FFT computation is performed when you specify an operator that uses FFT computation (LS, PS, PSD, CS, TF, or CH). Set the number of FFT points, the window function, the damping rate, and Force1 and Force2.
The results of the FFT appear in the selected computation waveform. Other than the fact that no FFT window is displayed, this is the same as the FFT computation that can be performed from the FFT menu.

▶ See here.

Filter Settings (Filter Setup) - user-defined

When using FILT1 and FILT2 in user-defined computation, set the digital filter type, filter band, and cutoff frequency for each of the two filters (Filter1 and Filter2).

Filter Type (Filter Type) and Filter Band (Filter Band)

Filter Type (Filter Type)	Filter Band (Filter Band)
Gauss	Low-Pass
Sharp	Low-Pass, High-Pass, Band-Pass
IIR (Butterworth)	Low-Pass, High-Pass, Band-Pass

CutOff1 and CutOff2 (CutOff1/CutOff2)

Set the cutoff frequency. When Filter Band is set to Low-Pass or High-Pass, set CutOff1; when Filter Band is set to Band-Pass, set CutOff1 and CutOff2.
Selectable range: 2.0 to 30.0% of the sample rate
Resolution: Steps of 0.2% of the sample rate

Constant Settings (Constant Setup) - user-defined

Set values for K1 to K8.
The selectable range is −9.9999E+30 to 9.9999E+30.

Notes about Computation

- FFT computation can be performed through the configuration of settings in the Math menu or the FFT menu (▶ See here.). In the FFT menu, you can set the display format and choose a linear or logarithmic frequency domain (horizontal axis) scale. The data point and window function settings are shared for the Math and FFT menus. When you change the settings in one menu, the settings in the other menu are also changed.
- On models that do not have user-defined computation (/G2 option), when you enter the FFT menu and turn FFT computation on, the Math7 operators become invalid and Math7 cannot be used. On models that do have user-defined computation, when you enter the FFT menu and set FFT 1 and FFT 2 to ON, Math7 and Math8 cannot be used.
- When you perform FFT computation on 50 kpoint or more of data using the FFT menu, you cannot use computed waveforms.
- An icon ( ) appears in the center of the top of the screen when user-defined computation is being executed.
- Waveforms stored through hard disk recording cannot be computed.

Notes about Using the 16-CH Voltage Input Module

▶ See here.

12 FFT

You can display the power spectrum of an input waveform in the FFT window. On models with user-defined computation (/G2 option), you can display up to two FFT waveforms, and you can analyze the following spectrums in addition to the power spectrum. However, FFT analysis cannot be performed on waveforms stored through hard disk recording.

Linear spectrums, power spectrum densities, cross spectrums, transfer functions, and coherence functions

Turning the FFT On and Off (Display)

Set whether to perform FFT analysis. If you set this to ON, the FFT window appears.

- ON: FFT analysis is performed.
- OFF: FFT analysis is not performed.

Analysis Source Waveform (Source)

Set the analysis source waveform to one of the waveforms below.

CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] Math1 to Math6[4]

1 You can select the channel of an installed module. You cannot select the channel of a logic module.
2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.
4 You cannot select Math7 or Math8.

When analysis is performed on a linearly scaled channel, the scaled values are used.

Start Point and Number of FFT Points (Start Point and FFT Points)

Start Point (Start Point)

Set the computation start point. The default setting is −5 div.

Selectable range: −5 div to +5 div

The start point is similar to the settable range of the cursor display position in cursor measurement.

For details, see “Selectable Range of Cursor Positions.”

▶ See here.

Number of FFT Points (FFT Points)

You can set the number of points from the start of computation on the T-Y waveform to one of the options below.

1k, 2k, 5k, 10k, 20k, 50k, or 100k

Window Function (Window)

You can select the window function from the following options.

Rect (Rectangular window)

The rectangular window is suited to transient signals, such as impulse waves, which attenuate completely within the time window.

Hanning (Hanning window)

The Hanning window encourages continuity of the signal by gradually attenuating the parts of the signal located near the ends of the time window down to the 0 level. Hence, it is suited to continuous signals. The Hanning window has a higher frequency resolution than the flattop window.

FlatTop (Flattop window)

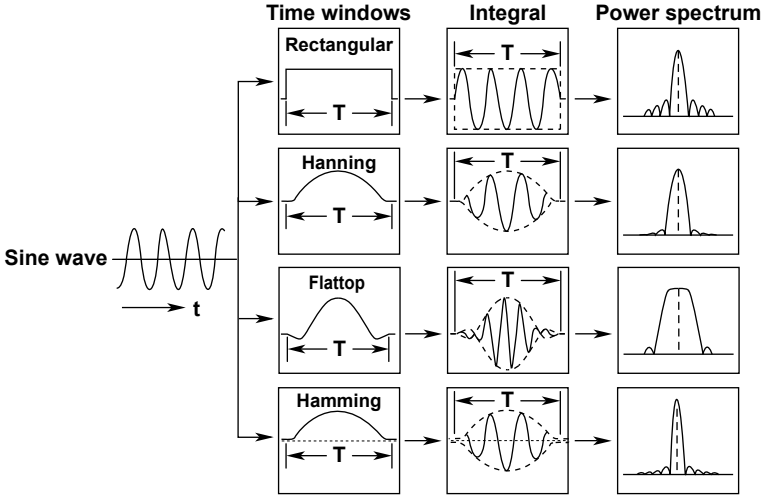
The flattop window encourages continuity of the signal by gradually attenuating the parts of the signal located near the ends of the time window down to the 0 level. Hence, it is suited to continuous signals. The flattop window has a higher spectral level accuracy than the flattop window.

Hamming (Hamming window)

In the Hanning window, the values at the ends become 0 and the signal components there do not affect the spectrum. The Hamming window is a corrected Hanning window. Its characteristics are similar to those of the Hanning window, but the frequency resolution of its main beam is greater than that of the Hanning window. The Hamming window is suited for dividing close signals.

Exponential (Exponential)

The exponential window removes noise from the signal. It can only be selected on models with the user-defined computation option. The exponential window is suited for the signals of impulse-excitation frequency-response tests and other similar signals.



Rectangular : $W(t) = u(t) - u(t - T)$ u(t): Step function

Hanning : $W(t) = 0.5 - 0.5\cos(2\pi\frac{t}{T})$

Flattop : $W(t) = \{0.54 - 0.46\cos(2\pi\frac{t}{T})\}\frac{\sin\{2\pi(1 - 2t/T)\}}{2\pi(1 - 2t/T)}$

Hamming : $W(t) = 0.54 - 0.46\cos(2\pi\frac{t}{T})$

For details about the exponential window, see appendix 2.

Vertical Scale (Vert. Scale Mode)

You can select the method for setting the vertical scale from the following options.

- Auto: The center and scale of the vertical axis are set automatically.
- Manual: The center and scale of the vertical axis must be set manually.

Center/Scale (Center/Sensitive)

When Vert. Scale Mode is set to Manual, set the center and scale of the vertical axis.

Display Ratio of the Main Window (Main Ratio)

▶ See here.

Window Layout (Window Layout)

Set the display position of the FFT window.

- Side: Horizontal
- Vertical: Vertical

Horizontal Scale (Horiz. Axis)

Select one of the following horizontal scale types.

- Hz: A normal (linear) scale is used.
- Log Hz: A logarithmic scale is used.

FFT Analysis on Models with User-Defined Computation (Option)

You can analyze the following types of spectrums on models with user-defined computation (/G2 option).

Linear spectrums, power spectrum densities, cross spectrums, transfer functions, and coherence functions

Turning FFT 1 and FFT 2 On and Off (Display)

Set whether to perform FFT analysis. If you set this to ON, the FFT windows appear. You can display separate FFT analysis results in the FFT 1 and FFT 2 windows.

- ON: FFT analysis is performed.
- OFF: FFT analysis is not performed.

FFT Settings (FFT Setup)

Set the spectrum type, the window function, and the type of averaging.

Spectrum Type (Type/Sub Type)

Set the spectrum type.

Type	Sub Type	Description
LS	MAG	Magnitude of the specified waveform's linear spectrum
LS	LOGMAG	Logarithmic magnitude of the specified waveform's linear spectrum
LS	PHASE	Phase of the specified waveform's linear spectrum
LS	REAL	Real part of the specified waveform's linear spectrum
LS	IMAG	Imaginary part of the specified waveform's linear spectrum
PS	MAG	Magnitude of the specified waveform's power spectrum
PS	LOGMAG	Logarithmic magnitude of the specified waveform's power spectrum
PSD	MAG	Magnitude of the specified waveform's power spectrum density
PSD	LOGMAG	Logarithmic magnitude of the specified waveform's power spectrum density
CS	MAG	Magnitude of the cross spectrum of the specified two waveforms
CS	LOGMAG	Logarithmic magnitude of the cross spectrum of the specified two waveforms
CS	PHASE	Phase of the cross spectrum of the specified two waveforms
CS	REAL	Real part of the cross spectrum of the specified two waveforms
CS	IMAG	Imaginary part of the cross spectrum of the specified two waveforms
TF	MAG	Magnitude of the transfer function of the specified two waveforms
TF	LOGMAG	Logarithmic magnitude of the transfer function of the specified two waveforms
TF	PHASE	Phase of the transfer function of the specified two waveforms
TF	REAL	Real part of the transfer function of the specified two waveforms
TF	IMAG	Imaginary part of the transfer function of the specified two waveforms
CH	MAG	Magnitude of the coherence function of the specified two waveforms

Analysis Source Waveforms (Source1 and Source2)[1]

Set the analysis source waveform to one of the waveforms below.
CH1 to CH16,[2] 16chVOLT,[3] CAN,[4] Math1 to Math6[5]

1 You can set Trace2 when Type is set to CS, TF, or CH.
2 You can select the channel of an installed module. You cannot select the channel of a logic module.
3 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.
4 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel. If the data type (Value Type) is set to Logic, you will not be able to select it.
5 You cannot select Math7 or Math8.

When analysis is performed on a linearly scaled channel, the scaled values are used.

Window Function (Window)

▶ See here.

- **Damping Rate (Damping Rate)**

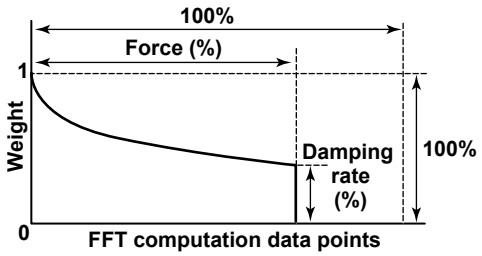
  You can configure this setting when Window is set to Exponential. You can set the value in the range of 1 to 100% (1% resolution). The weight of the last data point is used as a damping rate, with the weight of the first data point of the FFT computation taken to be 100% (= 1). When the damping rate is set to 100%, the window functions like a rectangular window. This setting applies to the input and output (response) signals.

- **Force1**

  You can configure this setting when Window is set to Exponential. Set the area over which computation is performed in terms of a percentage from the first FFT point, taking the number of FFT points to be 100%. You can set the area to a value from 1 to 100% (in 1% steps). When the area is set to 100%, the window functions like a rectangular window. The outer area is the average of the results of the window function for the data outside the area. This setting applies to the input signals (first parameter) of one-waveform and two-waveform FFTs.

- **Force2**

  You can configure this setting when Window is set to Exponential. This setting applies to the output (response) signal (second parameter) of a two-waveform FFT. It can be set in the same manner as Force1.



Average (Average)

FFT analysis data can be linearly or exponentially averaged, and its peak values can be computed.
These settings are the same as those for user-defined computation.

▶ See here.

Notes about FFT Computation

Notes about Displaying Power Spectrums

- You cannot display a power spectrum if the display record length is less than the number of computed data points.
- The following settings are shared for all computation channel: FFT Points, Window, and Start Point.
- You cannot magnify an FFT waveform along the horizontal access so that 50 points or fewer are displayed.

Notes about Computation

- Computation is normally performed on the sampled data in the acquisition memory. For waveforms that are acquired in Envelope mode, computation is performed on the maximum and minimum values at each acquisition interval.
- FFT computation can be performed through the configuration of settings in the Math menu or the FFT menu. The data point and window function settings are shared for the Math and FFT menus. When you change the settings in one menu, the settings in the other menu are also changed.
- • On models that do not have user-defined computation (/G2 option), when you enter the FFT menu and turn FFT computation on, the Math7 operators become invalid, and Math7 cannot be used. On models that do have user defined computation, when you enter the FFT menu and set FFT 1 and FFT 2 to ON, Math7 and Math8 cannot be used.
- When you perform FFT computation on 50 kpoint or more of data using the FFT menu, you cannot use computed waveforms.
- An icon ( ) appears in the center of the top of the screen when FFT computation is being executed.
- FFT analysis cannot be performed on waveforms stored through hard disk recording.

Notes about Using the 16-CH Voltage Input Module

▶ See here.

13 GO/NO-GO Determination

The DL850/DL850V determines whether the acquired waveform meets the reference condition (GO result) or not (NO-GO result). When the DL850/DL850V produces a GO or NO-GO result, it executes the specified actions.

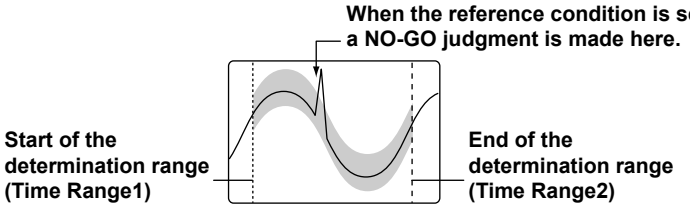
Mode (Mode)

Set the method for GO/NO-GO determination.

- OFF: GO/NO-GO determination is not performed.
- Waveform zone (Wave Zone): GO/NO-GO determination is performed using a waveform zone configured on the screen.
- Waveform parameter (Parameter): GO/NO-GO determination is performed through the use of the specified waveform parameters.

Waveform Zone (Wave Zone)

The DL850/DL850V returns GO/NO-GO results based on whether waveforms leave or enter the zone that you create using a base waveform.



Editing a Waveform Zone (Edit Zone)

Select the number of the waveform zone you want to edit from the range indicated below. If a zone has already been created for that number, the zone will be displayed. If no zone has been created for a number, select a base waveform from the base waveform editing menu (New), and then edit the zone.

Zone 1 to Zone 6 (Zone1 to Zone6), Cancel[1]

1 The selected menu closes.

Editing a Base Waveform (New)

When you create a new waveform zone, you need to select the waveform that you will base it on (the base waveform). Select a waveform whose display is on.

CH1 to CH16[1], Cancel (Cancel)[2]

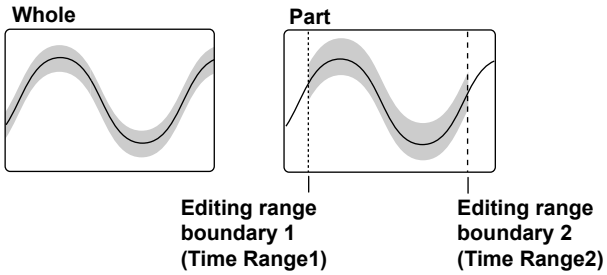
1 You can select the channel of an installed module. However, you cannot select the channel of a logic module, 16-CH Voltage Input Module, or CAN bus monitor module.

2 The selected menu closes.

Specifying the Editing Range (Edit)

Select the part of the base waveform that you want to edit.

- Whole (Whole): The whole waveform is within the editing range.
- Part (Part): A portion of the waveform is within the editing range.



Zone Settings

When Edit is set to Whole, you can set the upper, lower, left, and right boundaries of the waveform zone. When Edit is set to Part, you can set the upper and lower boundaries of the zone.

- Upper and lower boundaries (Upper and Lower)
  Selectable range: ±10 div vertically from the base waveform
  When Edit is set to Part, you can set the upper and lower boundaries of the area between Time Range1 and Time Range2.
- Left and right sides (Left and Right): These settings can only be configured when Edit is set to Whole.
  Selectable range: ±5 div from the center of the screen
- Time range 1 and time range 2 (Time Range1 and Time Range2): These settings can only be configured when Edit is set to Part.
  Selectable range: ±5 div on the time axis

Save Destination (Store as)

You can select one of the following save destinations for the waveform zone.

- Zone 1 to zone 6 (Zone1 to Zone6): The save destination is changed to the selected zone number.
- Cancel (Cancel): The save destination is not changed.

Saving a Waveform Zone (Execute Store)

Save the waveform zone.

Ending Editing (Quit)

Exit the waveform zone editor. If you do not press the Execute Store soft key to save the zone that you have edited, it will be lost.

Judgment Conditions (Judgement Setup)

For each of 16 judgment conditions, you can set the source waveform, zone number, and judgment criterion. You can also set the judgment logic, action condition, sequence, and acquisition count and enable or disable synchronization with a remote signal.

Judgment Criterion (Mode)

Select the judgment criterion from the following options.

- X: The condition is not used for GO/NO-GO determination.
- IN: The DL850/DL850V returns a GO result when the source waveform is within the GO/NO-GO determination zone. If even part of the source waveform is outside of the determination zone, the DL850/DL850V returns a NO-GO result.
- OUT: The DL850/DL850V returns a GO result when the entire source waveform is outside the GO/NO-GO determination zone. If even part of the source waveform is inside the determination zone, the DL850/DL850V returns a NO-GO result.

Source Waveform (Trace)

Set the waveform to use for GO/NO-GO determination to one of the waveforms below.
CH1 to CH16[1]

1 You can select the channel of an installed module. However, you cannot select the channel of a logic module, 16-CH Voltage Input Module, or CAN bus monitor module.

Zone Number (Zone No.)

Select the number of the waveform zone you want to use for GO/NO-GO determination from the range indicated below.
Zone 1 to zone 6 (Zone1 to Zone6)

Determination Logic (Logic)

You can select the determination logic from the following options.

- AND: The actions are performed when all the conditions from 1 to 16 are met.
- OR: The actions are performed when a condition from 1 to 16 is met.

Action Condition (ActCondition)

Set the action condition to one of the settings below.

- Always (Always): The actions are always performed. The actions will be executed each time that the DL850/DL850V triggers.
- At failure (Fail): The actions are executed when the specified GO conditions are not met.
- At success (Success): The actions are executed when the specified GO conditions are met.

Sequence (Sequence)

Select the sequence for executing actions.

- Single (Single): Execution stops after the actions are performed once.
- Continue (Continue): Actions are executed repeatedly. However, the actions stop repeating after the number of specified waveform acquisitions (the Acquisition Count setting). If Acquisition Count is set to Infinite, the actions continue until waveform acquisition is stopped by the pressing of the START/STOP key.

Acquisition Count (Acquisition Count)

Set the number of waveform acquisitions.

- Infinite: Waveform acquisition continues until it is stopped by the pressing of the START/STOP key.
- 1 to 65536: The DL850/DL850V stops waveform acquisition after it acquires the specified number of waveforms.

External Start (Ext Start)

You can perform GO/NO-GO determination and output the results in sync with an external signal applied to the GO/NO-GO I/O terminal of the DL850/DL850V.

- OFF: GO/NO-GO determination is not performed through the use of an external signal.
- ON: GO/NO-GO determination is performed through the use of an external signal.

Action (Action)

▶ See here.

Determination Period (Time Range1 and Time Range2)

You can set the determination period by setting Time Range1 and Time Range2. The default settings are −5 div and +5 div.

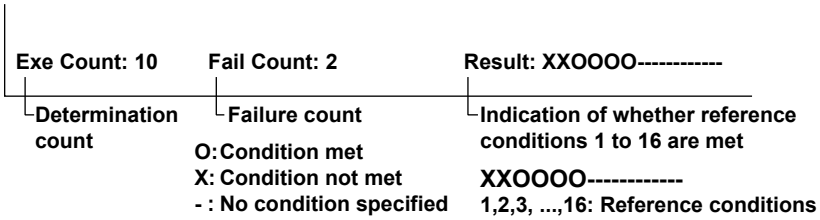
Selectable range: −5 div to +5 div

The determination period is similar to the settable range of the cursor display position in cursor measurement. For details, see “Selectable Range of Cursor Positions.”

▶ See here.

GO/NO-GO Determination Results

The results of GO/NO-GO determination (and the numbers of determinations and failures) appear at the bottom of the screen.



In this example, reference conditions 1 and 2 are not met while the conditions defined by base waveforms 3 to 6 are met.

Waveform Parameters (Parameter)

Set the upper and lower limits for automated measurement values of waveform parameters, and perform GO/NO-GO determination based on whether the values are within or outside of the limits.

Judgment Conditions (Judgement Setup)

For each of 16 judgment conditions, you can set the source waveform, waveform parameter, and upper and lower waveform parameter limits. You can also set the judgment logic, action condition, sequence, and acquisition count and enable or disable synchronization with an external start signal.

Judgment Criterion (Mode)

Select the judgment criterion from the following options.

- X: The condition is not used for GO/NO-GO determination.
- IN: The DL850/DL850V returns a GO result when the parameter is within the specified limits. The DL850/DL850V returns a NO-GO result when the parameter is outside the specified limits.
- OUT: The DL850/DL850V returns a GO result when the parameter is outside the specified limits. The DL850/DL850V returns a NO-GO result when the parameter is inside the specified limits.

Source Waveform (Trace)

Set the waveform to use for GO/NO-GO determination to one of the waveforms below.
CH1 to CH16[1]

1 You can select the channel of an installed module. However, you cannot select the channel of a logic module, 16-CH Voltage Input Module, or CAN bus monitor module.

Waveform Parameter (Item)

You can use all automatically measured waveform parameters as reference conditions. You can perform GO/NO-GO determination on up to 16 parameters at the same time.

▶ See here.

Upper and Lower Parameter Limit Settings (Upper/Lower)

Depending on the parameter, you can set the upper and lower limits within the range of −9.9999E+30 to 9.9999E+30.

Judgment Logic (Logic), Action Condition (ActCondition), Sequence (Sequence), Acquisition Count (Acquisition Count), and External Start (Ext Start)

▶ See here.

Action (Action)

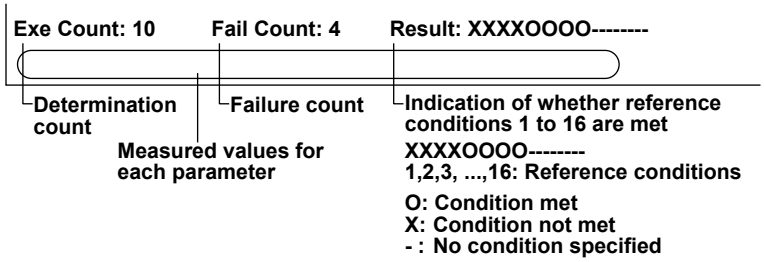
▶ See here.

Determination Period (Time Range1 and Time Range2)

▶ See here.

GO/NO-GO Determination Results

The results of GO/NO-GO determination (number of determinations, number of failures) appear at the bottom of the screen.



In this example, reference conditions 1 and 4 are not met while reference conditions 5 to 8 are met.

Notes about GO/NO-GO Determination

- During determination, all keys other than START/STOP are invalid.
- The determination interval is synchronized to the trigger. However, while actions are being performed after determination, the DL850/DL850V will not trigger.
- While you are accessing the DL850/DL850V through the FTP or Web server, if one of the following operations is performed, actions cannot be executed until you finish accessing the DL850/DL850V.
  Printing and saving of screen capture data and saving of waveform data
- When the GO/NO-GO mode is not set to OFF, computation and FFT analysis cannot be performed. Also, when computation or FFT analysis is enabled, the GO/NO-GO mode cannot be set to any setting other than OFF.

Notes about the “Save Data” and “Save Image” Actions

▶ See here.

Notes about Using the 16-CH Voltage Input Module

▶ See here.

14 Action-On-Trigger

You can make the DL850/DL850V execute specified actions whenever a trigger occurs.

Mode (Mode)

Select whether to use action-on-trigger.

- OFF: Action-on-trigger is not used.
- ON: The specified actions are executed whenever a trigger occurs.

Action (Action Setup)

You can select the actions that are performed when a trigger occurs from the options below.

Beep (Beep)

The DL850/DL850V sounds an alarm.

Screen Capture Printing (Print Image)

The DL850/DL850V prints a screen capture to the specified printer. You can specify a printer in the PRINT menu by setting “Print to” to BuiltIn (built-in printer) or Network (network printer).

▶ See here.

Waveform Data Saving (Save Data)

The DL850/DL850V saves the waveform data to the specified destination (SD card, internal or external HD [option], USB storage device, or network drive).

File Path (File Path)

Specify where to save the file.

▶ See here.

Auto Naming (Auto Naming), File Name (File Name), Data Format (Data Type)

These settings are the same as the auto-naming, file-name, and data-format settings for saving waveform data.

▶ See here.

Changing the auto-naming, file-name, and data-format settings for saving waveform data will change the auto-naming, file-name, and data-format settings under Waveform(SAVE) in the FILE menu.

Screen Capture Saving (Save Image)

The DL850/DL850V saves the screen capture data to the specified destination (SD card, internal or external HD [option], USB storage device, or network drive).

File Path (File Path), Auto Naming (Auto Naming), File Name (File Name)

▶ See here.

Changing the auto-naming and file-name settings for saving image data will change the auto-naming and file-name settings under Others(SAVE) in the FILE menu.

E-mail Sending (Send Mail)

The DL850/DL850V sends an e-mail to the specified address. Set the e-mail address by pressing UTILITY and then selecting Network > Mail.

▶ See here.

E-mail Send Count (Mail Count)

Set the upper e-mail transmission limit. When the number of transmitted e-mails reaches Mail Count, the DL850/DL850V stops sending e-mails.

Notes about Action-on-Trigger

- You cannot change settings while the action-on-trigger feature is active.
- The action-on-trigger actions may be slow if there is network access while the following operations are being performed.
  Printing and saving of screen capture data and saving of waveform data
- When the dual capture feature is enabled, the only action-on-trigger action that can be used is e-mail sending.
- When hard disk recording to an external or internal hard disk is enabled, the action-on-trigger feature cannot be used.

Notes about the “Save Data” and “Save Image” Actions

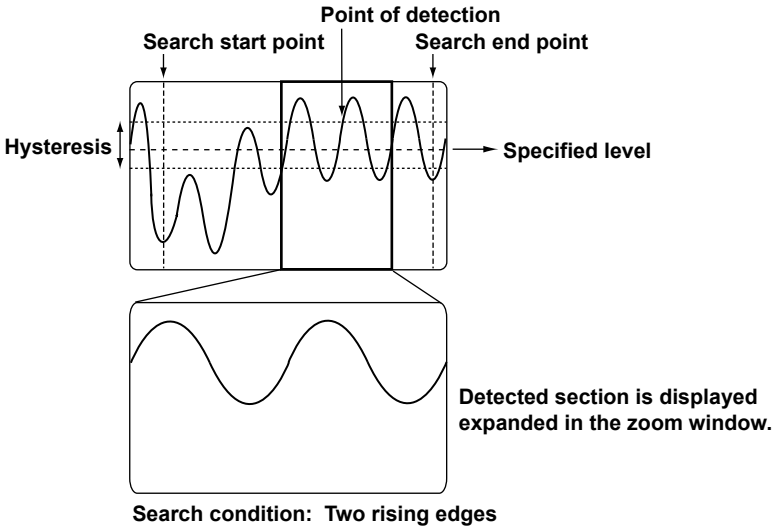
- Do not set the storage medium’s root folder as the save destination. (The DL850/DL850V can only store 512 files to the root folder of a storage medium that it has formatted.)
- The maximum number of files that can be created in a single folder is 1000. Make sure that there are no files in the destination folder before you start the action-on-trigger feature.
- If you select waveform data saving (Save Data) and screen capture saving (Save Image) at the same time, use the FILE menu to specify separate folders to save to.
- In the FILE menu, if you set Auto Naming to Numbering, as the number of saved files increases, the amount of time required to save a file will also increase.

Select whether to enable the action-on-trigger feature when the power is turned on.

▶ See here.

15 Searching Waveforms

You can search the displayed waveforms for locations that match the specified conditions. You can zoom-in on the detected locations. You can search the waveforms within the specified search range over up to 2 Gpoint. However, you cannot search through waveforms that have been stored through hard disk recording.



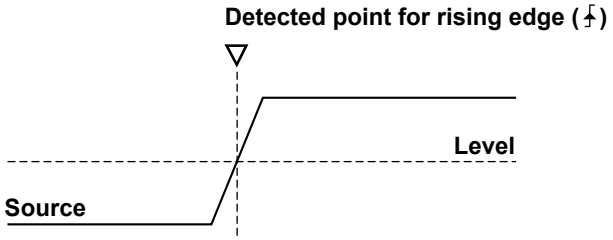
Search Type (Type)

Set the search type to one of the options below.

- Edge: The DL850/DL850V searches for edges.
- Event: The DL850/DL850V searches for an event.
- Logic Pattern: The DL850/DL850V searches for logic patterns. This setting is only valid for logic modules.
- Time: The DL850/DL850V searches for a time.

Edge Search (Edge)

Search for positions where the rising or falling slope of the specified waveform passes through the specified level.



Search Conditions (Setup)

Set the search conditions, such as the waveforms to search, judgment level, polarity, hysteresis, count, and bit settings.*

* Only on the channel of a logic module

Source Waveform (Trace)

Select the waveforms to search from the options listed below.

CH1 to CH16,[1] 16chVOLT,[2] CAN[3]

1 You can select the channel of an installed module.

2 If the 16-CH Voltage Input Module is installed. After you select 16chVOLT, select a sub channel.

3 On the DL850V when a CAN bus monitor module is installed. After you select CAN, select a sub channel.

Judgment Level (Level)

Set the level used to detect the rising or falling edges of the waveforms. You can set the level to a value within the 10 div of the screen. The resolution at which you can set the level varies depending on the module.

Polarity (Polarity)

Select which type of edge to detect from the options listed below.

- ↑: Rising
- ↓: Falling
- ↕: Rising or falling

Hysteresis (Hysteresis)

You can set a range (hysteresis) within which level changes are not treated as edges. You can set the hysteresis to one of the settings below. The hysteresis widths vary depending on the input module.

- Low hysteresis
- Medium hysteresis
- High hysteresis

Bit Settings (Bit Setting)

For each bit from Bit1 to Bit8, you can select which type of edge to detect from the options listed below. This setting is only available for the channels of logic modules. The DL850/DL850V searches based on the OR of each bit.

- ↑: Rising
- ↓: Falling
- ↕: Rising or falling
- −: The signal is not used as a trigger condition.

Count (Count)

Set the number of times the specified edge (↑, ↓, or ↕) must repeat. You can select a number from 1 to 1000000.

Searched Waveform Display (Result Window)

You can select whether to display the zoomed area around the point specified by Pattern No. in Zoom1 or Zoom2.
You only need to make this selection when both the Zoom1 and Zoom2 displays are turned on.

If the Zoom1 and Zoom2 displays are both off and you press SEARCH, the Zoom1 display turns on.

Detected Point Number (Pattern No.)

Specify the number of the detected point to display in the zoom window. The maximum detected point number is 1000.
If the search does not yield any results, “No Match” appears.

Search Range (Start Point and End Point)

Set the search start and end points (Start Point and End Point). The default settings are −5 div and +5 div.
Selectable range: −5 div to +5 div
The start and end points are similar to the settable range of the cursor display position in cursor measurement. For details, see “Selectable Range of Cursor Positions.”

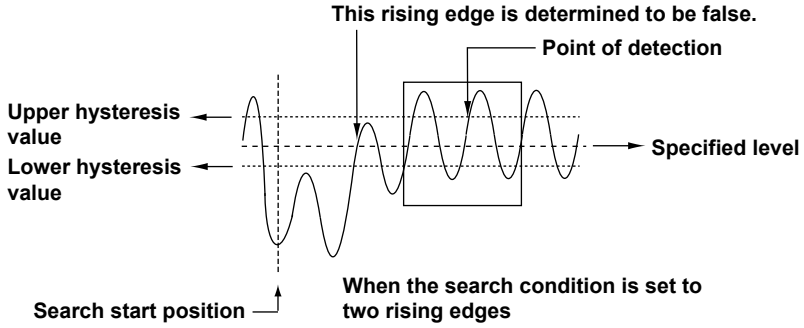
▶ See here.

Executing a Search (Execute)

The DL850/DL850V searches for positions where the specified search conditions are met. Then, the DL850/DL850V displays the waveforms expanded in the zoom window with the detected point that corresponds to the number you specify at the center.
Up to 1000 points can be detected.

Edge Search Determination

If the peak is below the upper limit of the hysteresis immediately after a rising edge or above the lower limit of the hysteresis immediately after a falling edge, the DL850/DL850V will not count the edge.


This rising edge is determined to be false.
Point of detection
Upper hysteresis value
Lower hysteresis value
Specified level
Search start position
When the search condition is set to two rising edges

Event Search (Event)

You can search for an event number that was assigned during measurement.

Event Number (Select Number)

Select the event number that you want to search for. You can select a number from 1 to 100.

Searched Waveform Display (Result Window)

▶ See here.

Event Type (Select Event)

Select the type of event that you want to detect.

- Capture: A dual-capture event
- Manual: A manual event assigned through the application of a signal to the EXT I/O terminal.

Executing a Search (Execute)

The DL850/DL850V displays the waveforms of the area around the selected event number expanded in the zoom window.

▶ See here.

Logic Pattern Search (Logic Pattern)

The DL850/DL850V searches for the specified logic pattern. This setting is only valid for logic modules.

Search Conditions (Setup)

Set the following search conditions: the waveforms to search, bit settings, and count.

Source Waveform (Trace)

Select the waveforms to search from the options listed below.

CH1 to CH16*

* You can only select the channel of a logic module.

Bit Settings (Bit Setting)

To set the logic signal pattern that you want to detect, set the signal states for Bit1 to Bit8. The DL850/DL850V searches based on the AND of each bit.

- H: High level
- L: Low level
- X: The state of the bit is not used as a condition.

Count (Count)

Set the number of times the specified pattern must repeat. You can select a number from 1 to 1000000.

Searched Waveform Display (Result Window), Detected Point Number (Pattern No), Search Range (Start Point and End Point), Executing a Search (Execute)

▶ See here.

Time Search (Time)

Search for a specific year, month, day, and time.

Search Conditions (Setup)

Specify the time that you want to search for.
Set the year (Year), month (Month), day (Day), hour (Hour), minute (Minute), second (Second), and microsecond (µSecond).

Searched Waveform Display (Result Window)

▶ See here.

Executing a Search (Execute)

The DL850/DL850V displays the waveforms of the area around the specified time expanded in the zoom window.

▶ See here.

Notes about Searching Waveforms

- You cannot search during data acquisition.
- The search results are invalid after you:
  - Start data acquisition.
  - Change the settings.
- Undisplayed waveforms and waveforms stored through hard disk recording are not included in searches.
- If you invert or change the offset voltage of a waveform that has been selected as a waveform to search, the search is performed on the new waveform.

Notes about Using the 16-CH Voltage Input Module

▶ See here.

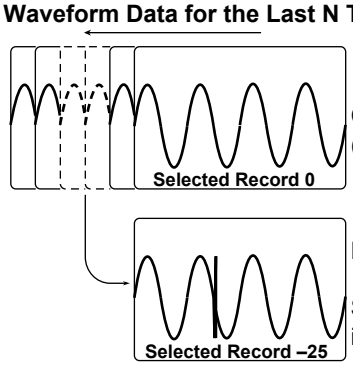
16 Displaying and Searching History Waveforms

Acquisition memory stores waveforms that are displayed on the screen and waveform data that have been acquired in the past. The history feature allows you to display or search past waveforms (history waveforms). You can perform the following operations on history waveforms:

Display

You can display any single waveform or display all waveforms (and highlight only the specified waveform). You can also list the timestamps (the trigger times) of all history waveforms.

Waveform Data for the Last N Triggers Is Stored



Current displayed waveform (Select Record = 0)

Past waveform

Set Select Record to a value in the range of 0 to – (N – 1).

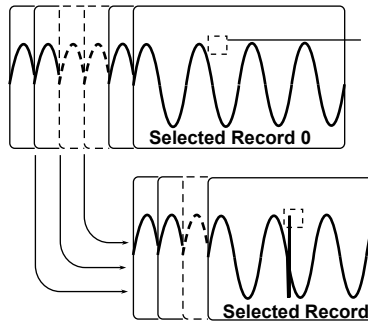
Search

You can search for waveforms that meet the specified conditions, display the detected history waveforms, and list the timestamps of the waveforms.

Zone Search

You can search for history waveforms that did or did not pass through a specified search zone.

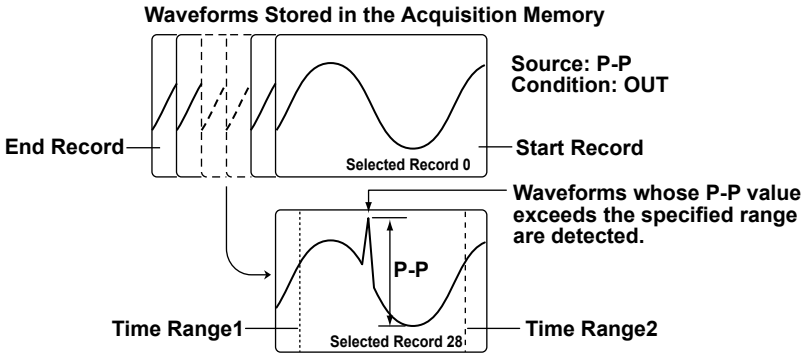
Waveforms Stored in the Acquisition Memory



Only waveforms that pass through the specified area are detected and displayed.

Parameter Search

You can search for history waveforms that do or do not meet specified search parameter conditions.



History Waveform Search Range

The search range is from Start Record to End Record.

Search Method

The DL850/DL850V starts searching in order from the newest waveform.

Calculation, Cursor Measurement, Automated Measurement, Statistical Processing, and FFT

You can perform calculations, cursor measurement, automated measurement of waveform parameters, or FFT analysis on the history waveform that you specified with Selected Record. You can also calculate statistics of automatically measured values on all history waveforms.

Displaying and Analyzing XY Waveforms

You can display XY waveforms and perform analysis on the history waveform you specified with Selected Record. If the display mode is set to All, XY waveforms of all history waveforms are displayed.

Display Mode (Display Mode)

Selects how history waveforms are displayed.

- One waveform (1 Record): Only the waveform that corresponds to the selected record number is displayed.
- All waveforms (All Record): All history waveforms from the specified start (Start Record) to stop (End Record) number are overlaid. All waveforms other than the highlighted one are displayed in an intermediate color.
- Averaged waveform (Average Record): Linear averaging is performed on all history waveforms from the specified start (Start Record) to stop (End Record) number, and the results are displayed as a single waveform.

An averaged waveform cannot be displayed for the following history waveforms.

Waveforms with record lengths of 250 kpoint or greater on the standard model, 1 Mpoint or greater on models with the /M1 option, or 2.5 Mpoint or greater on models with the /M2 option.

Highlighting (Selected Record)

The latest history waveform is assigned the record number zero, and older waveforms are assigned numbers in descending order (−1, −2, −3, and so on).

The waveform and timestamp that correspond to the record number you specify here are highlighted.

Selectable range: 0 to −(the number of waveform acquisitions − 1)

Maximum Number of Waveform Acquisitions

(Maximum number of history waveforms that can be stored in the acquisition memory)

The number of history waveforms that can be stored varies depending on the selected record length and the installed memory options as follows:

Record Length	Number of Waveforms		
	No options (250 Mpoint)	/M1 Option (1 Gpoint)	/M2 Option (2 Gpoint)
1 kpoint	5000	5000	5000
2.5 kpoint	5000	5000	5000
5 kpoint	2976	5000	5000
10 kpoint	1487	5000	5000
25 kpoint	593	2381	5000
50 kpoint	295	1189	2381
100 kpoint	144	583	1168
250 kpoint	57	236	474
500 kpoint	28	116	235
1 Mpoint	13	54	111
2.5 Mpoint	4	22	46
5 Mpoint	1	10	22
10 Mpoint	1	4	10
25 Mpoint	1[1]	1	4
50 Mpoint	1[2]	1	1
100 Mpoint	1[3]	1[1]	1
250 Mpoint	1[4]	1[2]	1[1]
500 Mpoint	−	1[3]	1[2]
1 Gpoint	−	1[4]	1[3]
2 Gpoint	−	−	1[4]

1 Only eight channels' worth of history waveforms are acquired.
2 Only four channels' worth of history waveforms are acquired.
3 Only two channels' worth of history waveforms are acquired.
4 Only one channel's worth of history waveforms are acquired.
− This record length cannot be set.

Display Range (Start and End Record)

Using record numbers, set the range of history waveforms to display when the display mode is set to All or Average.

Selectable range: 0 to −(the number of waveform acquisitions −1)

List of History Waveforms (List)

The history waveform record numbers and the times when the waveforms were acquired are listed.

History Waveform Search Mode (Search Mode)

When waveform acquisition is stopped, you can search for history waveforms that meet the specified conditions.

- OFF: Searching is not performed. All history waveforms are displayed.
- Zone: The DL850/DL850V searches for history waveforms that did or did not pass through a specified search zone.
- Parameter: The DL850/DL850V searches for history waveforms that do or do not meet specified search parameter conditions.

Search Condition Settings for Zone Searching (Search Setup)

Search Zone (Select Zone)

You can register four search zones to Zone1 to Zone4. For each search zone, set the channels to search, the search condition, and the search range.

Search Condition (Condition)

IN: The DL850/DL850V searches for waveforms that pass through the specified search window.
OUT: The DL850/DL850V searches for waveforms that do not pass through the specified search window.
OFF: The DL850/DL850V does not search for waveforms.

Source Waveforms (Source)

The DL850/DL850V searches through the waveforms that you select for Source. You can select waveforms from CH1 to CH16. The waveforms of channels that have not been specified as search source channels are also displayed. However, you cannot search through the waveforms of a logic module, 16-CH Voltage Input Module, or CAN bus monitor module.

Search Window Upper and Lower Limits (Upper and Lower)

You can set the limits within ±5 div. You can set them in 0.01 div steps.
You cannot set the upper limit to a value that is less than the lower limit.

Left and Right Sides of the Search Window (Left and Right)

You can set the left and right sides within the range of ±5 div. The resolution is 10 div/display record length.
You cannot set the left side to a value that is greater than the right side.

Search Logic (Logic)

AND: The DL850/DL850V searches for waveforms that meet all the search conditions specified for Zone1 to Zone4.
OR: The DL850/DL850V searches for waveforms that meet at least one of the search conditions specified for Zone1 to Zone4.

Search Condition Settings for Waveform Parameter Searching (Search Setup)

Search Parameter (Select Param)

You can register four search conditions to Param1 to Param4. For each search condition, you can change the channels to search, the search condition, and the search range.

Search Condition (Condition)

IN: The DL850/DL850V searches for waveforms in which the specified parameter is within the specified range.
OUT: The DL850/DL850V searches for waveforms in which the specified parameter is outside the specified range.
OFF: The DL850/DL850V does not search for waveforms.

Source Waveforms and Parameters (Source)

The DL850/DL850V searches through the specified parameter of the specified trace (Trace). You can specify one type of automatically measured waveform parameter. However, you cannot search through the waveforms of a logic module, 16-CH Voltage Input Module, or CAN bus monitor module.

Search Condition Upper and Lower Limits (Upper and Lower)

Specify the range used to determine the condition of the specified parameter.

Search Logic (Logic)

AND: The DL850/DL850V searches for waveforms that meet all the search conditions specified for Param1 to Param4.
OR: The DL850/DL850V searches for waveforms that meet at least one of the search conditions specified for Param1 to Param4.

Parameter Measurement Time Period (Time Range1/Time Range2)

You can set the measurement time period for the specified parameter by setting Time Range1 and Time Range2. The default settings are −5 div and +5 div. The number of data points in the measured waveform can be up to 100 Mpoint from the start of the measurement time period.
Selectable range: −5 div to +5 div
The measurement time period is similar to the settable range of the cursor display position in cursor measurement.
For details, see “Selectable Range of Cursor Positions.”

Search Execution (Execute Search)

Searches for waveforms that meet the specified search conditions and displays only the waveforms and timestamps that are detected.

Notes about Using the History Feature

Notes about Configuring the History Feature

- You cannot use the history feature when you are using the dual capture feature or during hard disk recording.
- When the acquisition mode is set to Average, you cannot use the history feature.
- If you stop waveform acquisition, even if one complete screen’s worth of waveform data has not been acquired, the waveform at which the trigger occurred is displayed as a single history waveform.
- If you stop waveform acquisition and then start it again without changing the waveform acquisition conditions, the waveform data continues to be stored in the acquisition memory.
- If you change the waveform acquisition conditions and start waveform acquisition, the past data stored in the acquisition memory is cleared.
- An averaged waveform cannot be displayed for the following waveforms.
  Waveforms with record lengths of 250 kpoint or greater on the standard model, 1 Mpoint or greater on models with the /M1 option, or 2.5 Mpoint or greater on models with the /M2 option.

Notes about Recalling Data Using the History Feature

- You cannot use the history feature while waveform acquisition is in progress.
- The settings are restricted so that the following relationship is retained: Last record (End Record) ≤ Selected Record ≤ first record (Start Record).
- Waveform data is always loaded from the specified storage medium to record number 0. When there are multiple records, the most recent waveform is placed in record number 0, and other waveforms are placed in order in record numbers −1, −2, and so on.
- Computation and automated measurement of waveform parameters are performed on the waveform of the record number specified by Selected Record. You can analyze old data as long as you do not restart waveform acquisition and overwrite the contents of the history. However, when an averaged waveform is displayed (Average Record), you cannot recompute the data even if you change the record number.
- The times that are listed are the waveform trigger times. These times vary as indicated below depending on the trigger mode.

Trigger Mode	Condition	Time Displayed in the List
Auto/Auto Level	Roll mode	Stop time
Single	Roll mode, no trigger	Stop time
On Start	−	Start time

- When all the waveforms are displayed, if a large number of records are selected, it may take time for them to be displayed completely. When the display is not complete, appears in the center of the screen. If you want to stop the operation, set Display Mode to 1 Record.
- The history memory is cleared when you turn the power off.

17 Printing and Saving Screen Captures

You can print screen captures from a built-in printer (option) or a network printer, save images to files, and so on.

Destination Type (Print To)

You can save screen captures and print them on the following types of printers.

- Built-in printer (BuiltIn): You can select this option when the optional built-in printer is installed.
- Network printer (Network): You can select a network printer that the DL850/DL850V is connected to. You must configure the network printer in advance.
- File (File): You can save screen captures to files in PNG, BMP, and JPEG formats.

Printing from the Built-In Printer (BuiltIn; option)

Models that have the optional built-in printer installed can print from it. Images printed from the built-in printer are printed just as they are displayed on the DL850/DL850V.

Comment (Comment)

You can enter a comment of up to 26 characters in length. The comment that you create is displayed in the bottom of the screen.
Changing this comment also changes the network printer and file comments.

Printing from a Network Printer (Network)

You can select a network printer that the DL850/DL850V is connected to. You must configure the network printer in advance.

▶ See here.

Images printed from the network printer are printed just as they are displayed on the DL850/DL850V.

Printer Type (Format)

The printers that the DL850/DL850V can use are listed below.

- HP Inkjet: HP inkjet printers
- HP Laser: HP laser printers
- EPSON Inkjet: EPSON inkjet printers

Color (Color)

You can select the color format to print in from the options below.

- ON: The DL850/DL850V prints using the same colors as the screen, excluding the background color. The grid and some other items are printed in black.
- OFF: The DL850/DL850V prints in the same way that it prints from the built-in printer.

Comment (Comment)

You can enter a comment of up to 26 characters in length. The comment that you create is displayed in the bottom of the screen.
Changing this comment also changes the built-in printer and file comments.

Saving Screen Captures to Files (File)

You can save screen captures to files in PNG, BMP, and JPEG formats.

Data Format (Format)

You can select the format to save to from the options listed below.

- PNG: The extension is .PNG. The file size is approximately 50 KB for black and white mode and approximately 100 KB for color mode.
- BMP: The extension is .BMP. The file size is approximately 150 KB for black and white mode and approximately 2 MB for color mode.
- JPEG: The extension is .JPG. The file size is approximately 250 KB for color mode.

The file sizes listed here are for reference. Actual file sizes will vary depending on the image that is saved.

Color (Color)

You can select the color format to save to from the options below.

- ON: Saves data using 65536 colors.
- ON (Gray): Saves data using 16 grayscale levels.
- ON (Reverse): Saves data using 65536 colors. The image background is set to white.
- OFF: Saves data in black and white.

Background Transparent or Opaque (Background)

For PNG format, you can save the waveform display area with a transparent background. This feature is convenient when you want to compare waveforms by overlaying screen captures on the PC.

- Normal (Normal): Saves data without changing the background (not made transparent).
- Transparent (Transparent): Saves data by making the background transparent.

Frame On or Off (Frame)

For JPEG format, you can add a white frame to the image to prevent the surrounding area from dropping out when the capture is printed.

- ON: The capture is saved with a frame.
- OFF: The capture is saved without a frame.

File Name Setting (File Setup)

You can set file names, comments, and so on. This is the same as the file feature.
Changing the comment also changes the built-in printer and network printer comments.

▶ See here.

Printing or Saving a Screen Capture (PRINT)

The screen capture is printed from the specified printer or saved to the specified file.

18 Saving and Loading Data

You can save the following kinds of data to an SD memory card, USB storage device, internal or external hard disk, or network drive.

Waveform data, setup data, screen capture data, snapshot waveform data, automated measurement data of waveform parameters

You can load the following types of data from a storage medium into the DL850/DL850V.

Waveform data, setup data, snapshot waveform data

You can also rename and copy files and set or clear protection on files.

Storage Media You Can Save and Load From

The DL850/DL850V can access the following five types of storage media for saving and loading data.

SD Memory Card (SD-1)

The SD memory card inserted into the SD memory card slot of the DL850/DL850V.

USB Storage Medium (USB-0 or USB-1)

A USB storage device that is connected to the DL850/DL850V USB port. USB2.0 mass storage devices compatible with USB Mass Storage Class Ver. 1.1 can be connected to the DL850/DL850V.

Internal Hard Disk (HD-0)

The internal hard disk installed on models with the /HD1 option.

External Hard Disk (HD-0)

An external hard disk connected to the EXT HDD connector on models with the /HD0 option. You can connect an external hard disk that supports eSATA.

Network Drive (Network)

A storage device on the network. You can use a network storage device by connecting the DL850/DL850V to an Ethernet network.

Notes about Using the USB Memory

- Connect USB storage media directly, not through a USB hub.
- Only connect a compatible USB keyboard, mouse, or storage device to the USB connector for peripherals.
- Do not connect and disconnect multiple USB devices repetitively. Provide a 10-second interval between removal and connection.
- Do not connect or remove USB cables from the time when the DL850/DL850V is turned on until key operation becomes available (approximately 20 to 30 seconds).
- You can use USB storage media that are compatible with USB Mass Storage Class Ver. 1.1.
- The DL850/DL850V can handle up to four storage media. If the connected medium is partitioned, the DL850/DL850V treats each partition as a separate storage medium. As such, the DL850/DL850V can handle up to four partitions.

Saving Data (Save)

The DL850/DL850V saves data to the specified storage medium.

Press SHIFT and then SAVE to display the SAVE menu. On this menu, you can configure the waveform-data and screen-capture-data save operations. Press SAVE (without SHIFT) to execute the save operation. On the menu for configuring the save operation (the SAVE menu), you cannot turn off both the waveform-data and screen-capture-data save operations.

Saving Waveform Data (Waveform)

You can save the waveform data that the DL850/DL850V has measured to a file in binary, ASCII, or floating-point format.

Save Destination (File List)

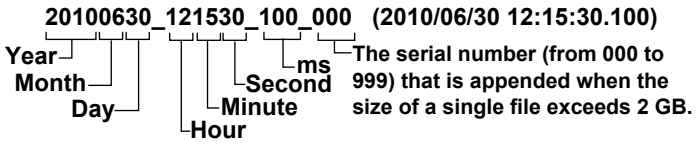
Specify the file to save to.

File Name (File Name)

Set the file name.

- You can use the auto naming feature to automatically assign file names.
- Whether Auto Naming is set to Numbering, Date, or OFF, when the size of a single file exceeds 2 GB, an underscore and a three-digit serial number (000 to 999) are appended to the file names.

File Name Example for When Auto Naming Is Set to Date



- The underscore and three-digit serial number are not appended to the file name when the file size is 2 GB or less. However, when a file is saved through the hard disk recording feature, an underscore and the three-digit serial number 000 are appended to the file name even if the file size does not exceed 2 GB.

- **Auto Naming (Auto Naming)**
  - Numbering (Numbering)
    The DL850/DL850V automatically adds a four-digit number from 0000 to 9999 after the common name specified using the File Name setting (up to four characters) and saves files.
  - Date (Date)
    The file name is the date and time (down to ms) when the file is saved. The file name specified using the File Name setting is not used.
  - OFF
    Disables the auto naming feature. The name that you specify using the File Name setting is used. If there is a file with the same name in the save destination folder, you cannot save the data.
  - Save Destination during Hard Disk Recording and Action Execution
    In the specified drive, a folder is automatically created with the date (year, month, and day) as its name, and data is saved to that folder using file names specified by the auto naming feature. If the number of files in the save destination folder exceeds 1000, a new folder is automatically created with the date and an incremented sequence number (000 to 999) as its name, and the data continues to be saved in the new folder.

- **File Name (File Name)**
  You can set the common file name that is used when the auto naming feature is turned off or when the auto naming feature is set to Numbering. The maximum number of characters that you can use for file names and folder names is 64 characters. The following restrictions apply.
  - The following types of characters can be used: 0 to 9, A to Z, a to z, _, −, =, (,), {, }, [,], #, $, %, &, ~, !, `,and @. @ cannot be entered consecutively.

- The following character strings cannot be used due to MS-DOS limitations.
  AUX, CON, PRN, NUL, CLOCK, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, or COM9
- Make sure that the full file path (absolute path from the root directory) is less than or equal to 260 characters in length. If it exceeds 260 characters, an error occurs when you perform a file operation (such as save, copy, rename, or create folder). When an operation is being performed on a folder, the full path is up to the name of the folder. When an operation is being performed on a file, the full path is up to the name of the file.

The following additional restrictions apply when you use the file name auto naming feature.

- If you set auto naming to Numbering, file names will be eight characters long. A file name will consist of the four characters that you entered for the file name and a four-character sequence number.
- If you set auto naming to Date (date and time), the characters that you entered for the file name will not be used. File names will only consist of the date information.

- **Comment (Comment)**

  You can add a comment that consists of up to 120 characters when saving files. You do not have to enter a comment. All characters, including spaces, can be used in a comment.

Data Type (Data Type)

Set the data type to binary, ASCII, or floating point.

- **Binary (Binary)**
  - The sampled data stored to the acquisition memory is saved to a file in binary format. The extension is .WDF. A thumbnail file is also saved at the same time. The thumbnail file can be viewed in the File Property screen.
  - You can load the saved binary format data into the DL850/DL850V, display the waveform of the data, and view the values that it contains. Accumulate is always set to OFF for loaded data.
  - If you save a waveform measured using the dual capture feature in binary format, the main waveform data and captured waveform data are saved to the same file.

- **ASCII (ASCII)**
  - The sampled data stored in the acquisition memory is converted using the specified range and saved to a file in ASCII format. The extension is .CSV. You can use the file to analyze waveforms on your PC.
  - You cannot load the file into the DL850/DL850V.
  - Waveforms measured using the dual capture feature are saved simultaneously to separate main-waveform-data and captured-waveform-data files. The captured-waveform-data file is automatically saved to the same name as the main-waveform-data file with DC added to the end of the file name.
    If you configure the record length and the number of channels so that the size of a file would exceed 2 GB, the file cannot be created.

- **Floating Point (Float)**
  - The sampled data stored in the acquisition memory is converted using the specified range and saved to a file in 32-bit IEEE floating format. The extension is .FLD. You can use the file to analyze waveforms on your PC. The data notation is little-endian (Intel format).
  - You cannot load the file into the DL850/DL850V.
  - Waveforms measured using the dual capture feature are saved simultaneously to separate main-waveform-data and captured-waveform-data files. The captured-waveform-data file is automatically saved to the same name as the main-waveform-data file with DC added to the end of the file name.
    If you configure the record length and the number of channels so that the size of a file would exceed 2 GB, the file cannot be created.

Data Size

The data sizes indicated below are for when the record length is 100 kpoint and you save the measured data from CH1 to CH4 with all computed waveforms turned off and one history waveform.

Data Type	Extension	Size (In bytes)
Binary	.WDF	Approx. 800 K: (100 kpoint + 32) × 4 channels × the number of history waveforms × 2
	.HDR	Approx. 2 K (approx. 3 K when Math1 and Math2 are set to ON)
ASCII	.CSV	4 to 5 Mpoint
Float	.FLD	Approx. 1.6 M: (100 kpoint + 32) × 4 × the number of history waveforms × 4

Save Range (Range)

You can select the waveform save range (area) from one of the choices below.

- Main window (Main): Saves the data displayed in the main window
- Zoom 1 or Zoom2 (Zoom1 or Zoom2): Saves the data displayed in the specified zoom window
- Cursor range (Cursor Range): Saves the data in the area between the cursors

Save Conditions (Waveform Save Setup)

- **Waveform to Save (Select Save Trace)**
  - You can select All ON, CH1 to CH16,[1] 16chVOLT,[2] CAN,[3] and Math. The waveforms you select that are displayed are saved. Even if you select All ON, only the waveforms that are displayed are saved.
    1 You can select the channel of an installed module.
    2 If the 16-CH Voltage Input Module is installed. You cannot select sub channels.
    3 When a CAN bus monitor module is installed. You cannot select sub channels.
  - The vertical-axis, horizontal-axis, and trigger settings are also saved along with the waveforms.

- **Saving History Waveforms (History)**

  You can set the source waveform to one of the waveforms below.
  - One waveform (One): Only the waveform with the record number specified in the history menu is saved.
  - All waveforms (All): All history waveforms between the start and end numbers specified in the history menu are saved.

  To save an averaged history waveform, set the display mode in the history menu to Average Record, and set History to One.

- **P-P Compression (P-P Comp)**

  When you save waveform data in binary format, you can choose whether to use P-P compression on it.
  - ON: P-P compression is used on the data before it is saved.
  - OFF: The data is saved without being P-P compressed.

- **Data Removal Interval (Interval)**

  When you save data in ASCII format, you can thin out the data before you convert it to ASCII format. Set the data removal interval.

  OFF (no data is removed), 5 points (Per 5), 10 points (Per 10), 20 points (Per 20), 50 points (Per 50), 100 points (Per 100), 200 points (Per 200), 500 points (Per 500), 1000 points (Per 1000), 2000 points (Per 2000), 5000 points (Per 5000)

  For example, if you select Per 5, the data will be removed as indicated below.

  First data point, +5, +10, +15...

- **Time Information (Time Info.)**

  When you save data in ASCII format, you can choose whether to save time information.
  - ON: Time information is saved.
  - OFF: Time information is not saved.

- **Extension (Extension)**

  When you save data in ASCII format, you can set the extension of the files that you save to .csv or .MATLAB.

- **Decimal Point (Decimal Point)**

  When you save data in ASCII format, you can choose how to separate the data.
  - Point (Point): The decimal point is a period, and the separator is a comma.
  - Comma (Comma): The decimal point is a comma, and the separator is a semicolon.

- **Saving Sub Channel Data (Sub Channel)**

  When you save data in ASCII format, you can choose whether to supplement the data of 16-CH Voltage Input Module sub channels.
  - Supplement (Supplement): Blank spaces are filled with repetitions of the same data so that the sub channels have the same amount of data as an ordinary channel.
  - Space (Space): Spaces are left where there is no data.

Notes about Using the 16-CH Voltage Input Module

▶ See here.

- If you change the extension of the saved data file, by using a PC or some other device, the DL850/DL850V will no longer be able to load it.
- Up to 1000 files and folders can be displayed in the file list. If there are more than a total of 1000 files and folders in a given folder, the file list for that folder will only display 1000 files and folders. There is no way to set which files and folders are displayed.
- Math waveforms are not saved if they are shorter than 10 div or if the computation start point is not −5 div.

Data Format for Saving Multiple Records

The DL850/DL850V saves data that contains multiple records, such as history waveforms, in the following data format.

ASCII format: CR+LF is inserted between records.

```
<Header>
CH1 data 1-1,   CH2 data 1-1, ...,   [CR+LF]
CH1 data 1-2,   CH2 data 1-2, ...,   [CR+LF]
                      ⋮                          One history record
CH1 data 1-m,   CH2 data 1-m, ...,   [CR+LF]
[CR+LF]
CH1 data 2-1,   CH2 data 2-1, ...,   [CR+LF]
CH1 data 2-2,   CH2 data 2-2, ...,   [CR+LF]
                      ⋮
CH1 data 2-n,   CH2 data 2-n, ...,   [CR+LF]
[CR+LF]
                      ⋮
```

Float format: Data is saved separately by channel.

Measured data for CH1 on record 1
Measured data for CH1 on record 2
⋮
Measured data for CH1 on record N
Measured data for CH2 on record 1
Measured data for CH2 on record 2
⋮
Measured data for CH2 on record N
⋮

Saving Setup Data (Setup)

You can save the DL850/DL850V setup information to the specified storage medium. The extension is .SET.

Save Destination (File List), File Name (File Name), Comment (Comment)

▶ See here.

Saving to Internal Memory

You can save setup data to internal memory from the Store/Recall menu.

▶ See here.

Saving Other Types of Data (Others)

You can save the following types of data.

Save Destination (File List), File Name (File Name), Comment (Comment)

▶ See here.

Data Type (Data Type)

- Screen capture (Screen Image): You can save the displayed screen image to a file in PNG, BMP, or JPEG format. You can also save the screen image from the menu that appears when you press the PRINT MENU key.
- Snapshot waveforms (Snap): You can save the waveform data captured in a snapshot. The extension is .SNP.
- Measure (Measure): You can save the results of the automated measurement of waveform parameters to a file in CSV format.

Automated Measurement Values of Waveform Parameters (Measure)

Save the results of automatic waveform parameter measurement to a file in CSV format. The extension is .CSV. CSV files are text files that contain data separated by commas. They are used to convert data between spreadsheet and database applications.
The maximum number of previous values that you can save is equal to 100000 ÷ number of items that are turned on.
Data size in bytes = Number of measured items × 15 × number of history waveforms

Saving (Execute Save)

Saves the data to the specified save destination with the specified file name.

Loading Data (Load)

You can load waveform data, setup data, and snapshot waveforms that have been saved by the DL850/DL850V.

Loading Waveform Data (Waveform)

Waveform data in binary format (files with .WDF extensions) can be loaded.
You can load a specified waveform data file with the setup data. You can load the entirety of the specified waveform data file. Waveforms of computed data appear when computation is turned on. Because setup data is also loaded, the DL850/DL850V settings change when you load waveform data. If you start waveform acquisition by pressing the START/STOP key, the loaded data is cleared.

- If the modules that are currently installed in the DL850/DL850V are different from the modules that were installed when the waveform data was saved, you cannot load the waveform data for the modules that are different.
- If you load waveform data saved by a module with a larger amount of memory on a module with a smaller amount of memory, the number of history waveforms, acquisition conditions, number of channels, and other settings are adjusted to match the condition of the module with the smaller amount of memory.
- You can only load waveform data that you saved with the save range set to the main window.

Loading Setup Data (Setup)

The setup data of the specified file is loaded. The extension is .SET.

Recalling Data from the Internal Memory

You can recall setup data from the internal memory from the save/load menu.

▶ See here.

If the modules that are currently installed in the DL850/DL850V are different from the modules that were installed when the setup data was saved, you cannot load the setup data for the modules that are different.

Loading Other Types of Data (Others)

The snapshot waveforms of the specified file or the contents of a symbol definition file are loaded.

Snapshot Waveforms (Snap)

The snapshot waveforms that you load are displayed in white on the screen. The extension is .SNP.

Symbol Definition Files (Symbol)

CAN data definition files whose extensions are .SBL.

▶ See here.

Loading (Execute Load)

Loads the data of the specified file.

File Operations (Utility)

You can perform file operations such as creating folders on the storage medium, deleting and copying files, and changing file names.

Sorting the List (Sort To)

You can sort the file list by file name, data size, date, etc.

Display Format

Select whether to display a list of files or to display thumbnails.

Selecting the Type of File to List (File Filter)

You can limit the type of files that appear in the list by selecting an extension.

Changing the Storage Medium (Change Drive)

You can select the storage medium that you want to access. The DL850/DL850V displays various storage media as follows:

- SD-1: The SD memory card inserted into the SD memory card slot of the DL850/DL850V
- USB-0: A USB storage device that is connected to a DL850/DL850V USB port (the first connected device)
- USB-1: A USB storage device that is connected to a DL850/DL850V USB port (the second connected device)
- HD-0: On models with the /HD0 option: an external hard disk that supports eSATA connected to the EXT HDD connector. On models with the /HD1 option: the internal hard disk.
- Network: A storage device on the network

Making Folders (Make Dir)

Make a folder.

You can use the same characters in folder names that you can in file names.

▶ See here.

Copying and Moving Files (Copy and Move)

You can copy or move the selected files and folders to other storage media or folders. You can copy or move multiple files at the same time.

Deleting Files and Folders (Delete)

You can delete the selected files and folders.

Renaming Files and Folders (Rename)

You can rename a selected file or folder.

Turning File Protection On and Off (Protect ON and OFF)

You can turn protection on and off for the selected file. The change is reflected in the file attributes, displayed under the Attr column in the file list.

Protection	File Attribute	Description
ON	r	File protection is on for the selected file. The file can only be read. The file cannot be written to or deleted.
OFF	r/w	File protection is off for the selected file. The file can be read and written to.

File Property (File Property)

You can view information about the selected file, such as its name (File Name), file size (File Size), the date and time when it was saved (Date/Time), and its attributes (Attribute).

Selecting Files (ALL SET, ALL RESET, and SET/RESET)

Selects or deselects all the files in the list.

You can also only select or deselect the highlighted files.

To format the storage medium, press the UTILITY key to display the System Config menu, and then select Storage Manager.

▶ See here.

19 Ethernet Communication (Network)

You can configure TCP/IP parameters and use the optional Ethernet interface to perform the following tasks.

To use this feature, set the communication interface to Network (from the UTILITY menu, select Remote Ctrl > Device > Network).

TCP/IP

TCP/IP settings for connecting to an Ethernet network.
Set the IP address, subnet mask, and default gateway.

▶ See here.

FTP Server (FTP/Web Server)

You can connect the DL850/DL850V as an FTP server to a network.
You can connect to the DL850/DL850V from a PC on the same network and retrieve waveform data.

▶ See here.

Web Server (FTP/Web Server)

You can connect the DL850/DL850V as a Web server to a network.
You can connect to the DL850/DL850V from a PC on the same network and monitor the DL850/DL850V display from the PC.

▶ See here.

Mail (Mail)

The action-on-trigger or GO/NO-GO action can be set to mail transmission.

▶ See here.

Network Printer (Net Print)

You can specify a network printer for printing screen captures.

▶ See here.

Network Drive (Net Drive)

You can save waveform data and setup data to a network drive through an Ethernet connection.

▶ See here.

SNTP

The DL850/DL850V clock can be set using SNTP. The DL850/DL850V can be configured to automatically adjust its clock when it is turned on.

▶ See here.

To connect a PC to the DL850/DL850V, use a hub or router, and connect to a network. Do not connect a PC directly to the DL850/DL850V.

TCP/IP (TCP/IP)

Configure the settings that the DL850/DL850V needs to connect to a network.

DHCP

DHCP is a protocol that temporarily allocates settings that a PC needs to connect to the Internet.
To connect to a network that has a DHCP server, turn the DHCP setting on. When DHCP is turned on, the IP address can be automatically obtained when the DL850/DL850V is connected to a network. (You do not have to set it manually.)
When DHCP is turned off, you must set the appropriate IP address, subnet mask, and default gateway for the network.

DNS

DNS is a system used to associate Internet host names and domain names with IP addresses. Given AAA.BBBBB.com, AAA is the host name and BBBBB.com is the domain name. You can use host names and domain names to access the network instead of using IP addresses, which are just numbers. The DL850/DL850V allows you to specify the host by name, instead of by IP address. Set the domain name and the DNS server address (0.0.0.0 by default). For details, consult your network administrator.

DNS Servers (DNS Server1/DNS Server2)

You can specify up to two DNS server addresses: primary and secondary. If querying fails with the primary DNS server, the secondary DNS server is automatically used to find the mapping of the host name and domain name to the IP address.

Domain Suffixes (Domain Suffix1/Domain Suffix2)

The domain suffix is a piece of information that is automatically added when a query is made to a DNS server using only a portion of the domain name. For example, if BBBBB.co.jp is registered as a domain suffix and a query is made using “AAA,” the name “AAA.BBBBB.co.jp” is searched.
You can specify up to two domain suffixes: Domain Suffix1 and Domain Suffix 2.
You can use up to 127 characters. The characters that you can use are 0 to 9, A−Z, a−z, and dashes.

TCP/IP settings are applied when you press BIND and then SET or when you turn on the DL850/DL850V the next time.

FTP Server (FTP/Web Server)

You can connect the DL850/DL850V as an FTP server to a network.
Set the user name and password that will be used by devices on the network to access the DL850/DL850V. Also, set the access timeout value.

User Name (User Name)

Set the user name that will be used to access the DL850/DL850V from a PC. The characters that you can use for the password are all the ASCII characters on the keyboard. If you set the user name to “anonymous,” you can connect to the DL850/DL850V without entering a password.

Password (Password)

Set the password that will be used to access the DL850/DL850V from a PC. The characters that you can use for the password are all the ASCII characters on the keyboard.

Timeout (Timeout)

If an ftp connection cannot be established between the DL850/DL850V and the PC within the amount of time specified here, the DL850/DL850V aborts the connection process.

To apply the settings that you specified, press Entry.

FTP Server Overview

When the DL850/DL850V is connected to the network as an FTP server, the following features become available.

FTP Server

From a PC, you can view a list of files that are stored in the DL850/DL850V storage medium (the internal memory or a storage medium that is connected to it) and retrieve files.

PC System Requirements

PC

A PC running Microsoft Windows XP Professional or Mac OS X.

OS

Microsoft Windows XP Professional or Mac OS X (10.4.8)

Internal memory

512 MB or more recommended.

Communication ports

100BASE-TX or 1000BASE-T Ethernet port. Use this port to connect the PC to the network.

Display

A display compatible with any of the above operating systems and with a resolution of 1024×768 or higher.

Mouse or pointing device

Mouse or pointing device compatible with any of the above operating systems

Web browser

Internet Explorer 6.0, Firefox 3.0, or Safari (3.2.1)

Web Server (FTP/Web Server)

You can connect the DL850/DL850V as a Web server to a network.
Set the user name and password that will be used by devices on the network to access the DL850/DL850V.
Also, set the access timeout value.

User Name (User Name)

Set the user name that will be used to access the DL850/DL850V from a PC. The characters that you can use for the password are all the ASCII characters on the keyboard. If you set the user name to “anonymous,” you can connect to the DL850/DL850V without entering a password.

Password (Password)

Set the password that will be used to access the DL850/DL850V from a PC. The characters that you can use for the password are all the ASCII characters on the keyboard.

To apply the settings that you specified, press Entry.

Web Server Overview

When the DL850/DL850V is connected to the network as an Web server, the following features become available.

Web Server

You can display the DL850/DL850V screen on the PC and start and stop measurement through the Ethernet network. You can refresh the DL850/DL850V screen that is displayed on the PC and take screen captures.

PC Operations

Setting the Screen Update Rate: You can set the update rate to 5 s, 10 s, 30 s, or 60 s.
Screen Update Start: The display starts updating automatically at the rate that you specify.
Screen Update Stop: You can stop the updating of the display.
Manually Update the Screen: You can update the display manually.
START/STOP: You can start and stop measurement on the DL850/DL850V.
Full Screen Capture: You can take full-screen screen captures.

PC System Requirements

▶ See here.

- You need Adobe Flash Player (version 8 or later) to use the Web server function. When visiting this Web site, the most recent Flash Player is automatically downloaded. If the download does not begin, please obtain the latest Flash Player from the Adobe Web site.
- When using the full screen capture function, be sure to disable pop-up blockers on your browser.
- The Web server function is unavailable when printing on the instrument or manipulating files.
- The Web server function can also not be used if the instrument is connected to a PC while the Mass Storage setting is enabled on the PC. After disconnecting the PC or enabling the USBTMC setting, restart the DL850/DL850V.

Mail (Mail)

You can send trigger times and other information in emails to a specific email address as an action in the action-on-trigger or GO/NO-GO determination feature.

Mail Server (Mail Server)

Specify the IP address of the mail server on the network that the DL850/DL850V will use. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

Mail Address (Mail Address)

You can specify multiple email recipient addresses. Separate each address with a comma.

Comment (Comment)

If necessary, you can enter a comment in the first line of e-mails.

Attaching Image Files (Attached Image File)

You can attach a capture of the screen that is displayed at the time the email is sent.

File format: The format that you set in the FILE menu for saving screen captures.
File name: DL_image[time].extension
(Example: DL Image1006171158.extension is a screen capture taken at 11:58 on June 17, 2010.)
Resolution: XGA (1024×768 dots)
Approximate File Size
Normal screen: Approx. 50 KB
Maximum: Approx. 1.6 MB (when the screen contains many colors)

Timeout (Timeout)

If the DL850/DL850V cannot send an email for the amount of time specified here, it disconnects from the mail server.

Sending a Test Mail (Send Test Mail)

You can send a test mail to check whether emails can be sent properly.

Network Printer (Net Print)

You can print screen captures on a network printer.
The DL850/DL850V can print to the following printers.

EPSON Inkjet printers (EPSON Inkjet)
HP inkjet printers (HP Inkjet)
HP laser printers (HP Laser)

LPR servers (LPR Server)

Specify the IP address of the printer server that the DL850/DL850V will connect to. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

LPR is a protocol used to print over a TCP/IP network.

LPR Name (LPR Name)

The name of the shared printer that the DL850/DL850V will connect to.

Timeout (Timeout)

If the DL850/DL850V cannot print for a certain amount of time, it disconnects from the network printer.

Network Drive (Net Drive)

You can save waveform data and setup data to a network drive through an Ethernet connection.

FTP Server (FTP Server)

Specify the IP address of the FTP server on the network that you want to save waveform or setup data to. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

Login Name (Login Name)

Specify the login name. The characters that you can use for the password are all the ASCII characters on the keyboard.

Password (Password)

Specify the password that corresponds to the login name. The characters that you can use for the password are all the ASCII characters on the keyboard.

Passive Mode (Passive)

Turn passive FTP on or off.
In passive mode, the FTP client sets the port number for data transfer. Enable passive mode when you have set an external FTP server as a network drive or when you are accessing an FTP server through a firewall.

Timeout (Time Out)

If the DL850/DL850V cannot transfer files for a certain amount of time, it disconnects from the FTP server.

Connecting to the Network Drive(Connect/Disconnect)

When you press the Connect button, the DL850/DL850V connects to the specified network drive, and the drive appears in the file list (File List). When you press the disconnect button, the network drive is disconnected and removed from the file list (File List).

SNTP (SNTP)

The DL850/DL850V clock can be set using Simple Network Time Protocol (SNTP). The DL850/DL850V can be configured to automatically adjust its clock when it is turned on.

SNTP Server (SNTP Server)

Specify the IP address of the SNTP server that the DL850/DL850V will use. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

Timeout (Timeout)

If the DL850/DL850V cannot connect to the SNTP server for a certain amount of time, it aborts the operation.

Executing Time Adjustment (Adjust)

The DL850/DL850V clock is synchronized to the SNTP server clock.

Automatic Adjustment (Adjust at Power On)

You can configure the DL850/DL850V so that its clock is automatically synchronized to the SNTP server clock when the DL850/DL850V is turned on when it is connected to the network.

- If the time difference from GMT (Greenwich Mean Time) is set in the date/time setting, the DL850/DL850V will make appropriate adjustments to the time information received from the SNTP server.
  ▶ See here.
- If you do not want the DL850/DL850V to synchronize with an SNTP server, do not set the SNTP server IP address.

20 Other Features

Auto Setup (Auto Setup)

The auto setup feature automatically sets the SCALE (vertical axis), TIME/DIV (horizontal axis), trigger level, and other settings to values that are most suitable for the input signals. This feature is useful when you are not sure what type of signal will be applied to the DL850/DL850V. The auto setup feature will not work properly on some input signals. There are some modules with which the auto setup feature cannot be used.

Center Position after the Execution of Auto Setup

The center position after you execute auto setup will be 0 V.

Modules That Support Auto Setup

701250 (HS10M12), 701251 (HS1M16), 701255 (NONISO_10M12), 701260 (HV (with RMS)), 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), 701275 (ACCL/VOLT), 720210 (HS100M12), 720220 (16CH VOLT)

Source Channels

The DL850/DL850V executes auto setup based on the signals of all channels excluding logic channels.

Waveforms Displayed before the Execution of Auto Setup

Waveforms that were displayed before you execute auto setup will be cleared.

Signals That Auto Setup Can Be Applied To

You can use auto setup for the following types of input signals.

- When module 720210 is installed: Simple, repeating signals with frequencies between 50 Hz and 10 MHz
  When module 720210 is not installed: Simple, repeating signals with frequencies between 50 Hz and 1 MHz
- Signals whose maximum absolute input voltage is 20 mV at 1:1 probe attenuation to the maximum range × 10

The auto setup feature may not work properly for signals that include a DC component or high-frequency components.

Undoing Auto Setup (Undo)

You can revert to the settings that were used immediately before you executed auto setup.

Initializing Settings (Initialize)

You can reset the DL850/DL850V settings to their factory default values. This feature is useful when you want to cancel all the settings that you have entered or when you want to redo measurement from scratch. Default reset refers to the act of resetting the DL850/DL850V settings to their factory default values.

Items That Cannot Be Reset

The following settings cannot be reset.

Date and time settings, communication settings, the language setting (Japanese or English), and environment settings

Undoing Default Reset (Undo)

If you perform default reset by mistake, you can undo it by pressing the Undo soft key.

To Reset All Settings to Their Default Values

While holding down the RESET key, turn the power switch on. All settings except the date and time settings (display on/off setting will be reset) and the setup data stored in internal memory will be reset to their factory default values. If you reset the settings using this method, the changes cannot be undone.

Storing and Recalling Setup Data (Setup Data Store and Recall)

You can save up to three sets of setup data to specific internal memory areas. It is convenient to save setup data that you use frequently. You can save a set of setup data to one of the following numbers.

1, 2, 3

By specifying these numbers, you can store and recall setup data easily.

You can attach comments in the same way that you can when you save waveform data.

▶ See here.

Calibration (CAL)

Executing Calibration (Execute Calibration)

Calibrates following items. Execute calibration when you want to make accurate measurements.

- Vertical-axis ground level

Calibration is performed automatically when the power switch is turned on.

Notes about Calibration

- Allow the DL850/DL850V to warm up for at least 30 minutes before you execute calibration. If you execute calibration immediately after power-on, the calibrated values may drift due to temperature changes or other environmental changes.
- Execute calibration in a stable temperature environment ranging from 5 to 40°C (23 ± 5°C recommended).
- Do not apply signals when calibrating. Calibration may not be executed properly when input signals are being applied to the DL850/DL850V.

Auto Calibration (Auto Calibration)

Auto calibration is executed when you start signal acquisition if any of the time periods listed below has elapsed since the power was turned on.

- Approx. 3 minutes
- Approx. 10 minutes
- Approx. 30 minutes and every 30 minutes thereafter

Snapshot (SNAP SHOT)

Retains the currently displayed waveforms on the screen. This feature allows you to update the display without having to stop waveform acquisition. It is a useful feature when you want to compare waveforms.

Snapshot waveforms are displayed in white.

You cannot perform the following operations on snapshot waveforms.

Cursor measurement, automated measurement of waveform parameters, zoom, or computation

You can save and load snapshot waveforms.

Clear Trace (CLEAR TRACE)

Clears all the waveforms that are displayed on the screen.

If you change the display format or perform other similar operations, the DL850/DL850V redisplays the channel waveforms, computed waveforms, and loaded waveforms that were displayed before you executed the clear trace operation.

Snapshot and clear trace features are disabled:

- When the DL850/DL850V is in remote mode.
- When the DL850/DL850V is printing, when it is executing auto setup, or when it is accessing a storage medium.
- When go/no-go determination is in progress, when action-on-trigger is in progress, or when searching is in progress.

Remote Control (Remote Ctrl)

Communication interface for controlling the DL850/DL850V from a PC. For details, see the communication interface user's manual, IM DL850-17EN.

Types of Communication Interfaces (Device)

USB, GP-IB, and Network are the available communication interfaces.

- Only use the selected communication interface. If you send commands simultaneously from another communication interface that has not been selected, the DL850/DL850V will not execute the commands properly.
- When the DL850/DL850V is in remote mode and is communicating with a PC, REMOTE appears in the center of the DL850/DL850V screen. All keys except SHIFT + CLEAR TRACE are disabled in Remote mode.

USB

Connects the DL850/DL850V to a PC using USB.

To remotely control the DL850/DL850V using communication commands through the USB port, select USBTMC and then carry out the following procedure.

- Install YOKOGAWA USB TMC (Test and Measurement Class) driver on your PC. For information about how to obtain the YOKOGAWA USB TMC driver, contact your nearest YOKOGAWA dealer. You can also access the YOKOGAWA USB driver download webpage and download the driver (http://tmi.yokogawa.com/service-support/downloads/).
- Do not use USB TMC drivers (or software) supplied by other companies.

GP-IB

Connects the DL850/DL850V to a PC using GP-IB.

Address (Address)

- You can set the address to a value from 0 to 30.
- Each device that is connected by GP-IB has its own unique address in the GP-IB system. This address is used to distinguish one device from other devices. Therefore, you must assign a unique address to the DL850/DL850V when connecting it to a PC or other device.

- Several cables can be used to connect multiple devices. However, no more than 15 devices, including the controller, can be connected on a single bus.
- When connecting multiple devices, you must assign a unique address to each device.
- When the controller is communicating with the DL850/DL850V or with other devices through GP-IB, do not change the address.
- Use cables that are 2 m or shorter in length to connect devices.
- Keep the total length of the cables under 20 m.
- When devices are communicating, have at least two-thirds of the devices on the bus turned on.
- To connect multiple devices, use a star or daisy-chain configuration. Loop and parallel configurations are not allowed.

Network

Connects the DL850/DL850V to a PC using Ethernet.

- You must set TCP/IP parameters to connect the DL850/DL850V to an Ethernet network.
  ▶ See here.
- To connect the DL850/DL850V to a PC, be sure to use straight cables through a hub. Correct operation is not guaranteed for a one-to-one connection using a cross cable.
- Use one of the following types of network cable that conforms to the transfer speed of your network.
  A UTP (Unshielded Twisted-Pair) cable
  An STP (Shielded Twisted-Pair) cable

System Configuration (System Configuration)

You can specify the following settings.

- DL850/DL850V date and time
- Language
- Click sound on/off
- LCD adjustment
- Format Internal Memory
- USB Keyboard Language
- USB Communication

Date and Time Settings (Date/Time)

The DL850/DL850V date and time.

Turning the Display On and Off (Display)

Set whether to display the date and time on the DL850/DL850V screen.

Display Format (Format)

You can display the date in one of the following formats.

2010/06/30 (year/numeric month/day)
30/06/2010 (day/numeric month/year)
30-JUN-10 (day-English abbreviation of the month-last two digits of the year)
30 JUN 2010 (day month (English abbreviation) year)

Date and Time Settings (Date/Time)

Sets the date and time.

Time Difference from Greenwich Mean Time (Time Diff. GMT)

Set the time difference between the region where you are using the DL850/DL850V and Greenwich Mean Time.

Selectable range: Set the time difference in the range of −12 hours 00 minutes to 13 hours 00 minutes.

For example, Japan standard time is ahead of GMT by 9 hours. In this case, set Time Hour to 9 and Minute to 00.

Checking the Standard Time

Using one of the methods below, check the standard time of the region where you are using the DL850/DL850V.

- Check the Date, Time, Language, Regional Options on your PC.
- Check the standard time at the URL on the right. http://www.worldtimeserver.com/

- The DL850/DL850V does not support Daylight Savings Time. To set the Daylight Savings Time, reset the time difference from Greenwich Mean Time.
- Date and time settings are backed up using the internal lithium battery. They are retained even if the power is turned off.
- The DL850/DL850V has leap-year information.

Time Synchronization Feature (Time Synchro; optional)

You can use this feature to use an IRIG (Inter Range Instrumentation Group) signal to synchronize the time on the DL850/DL850V with the GPS (Global Positioning System). This feature has three conditions: Unlock, Lock, and Stable. When an IRIG signal is properly received, the DL850/DL850V enters into the Lock condition and acquires time information.

Turning the Time Synchronization Feature On and Off (Time Synchro)

You can select whether to use an IRIG (Inter Range Instrumentation Group) signal for time synchronization.

IRIG Code Format (IRIG Format)

You can set the IRIG code format to A or B.

IRIG Code Modulation Type (Modulation)

You can set the IRIG code modulation type to AM or Pulse-width Code (PWCode).

Input Impedance (Impedance)

You can set the input impedance to 50 Ω or 5 kΩ.

The time synchronization feature has three conditions: Unlock, Lock, and Stable. When an IRIG signal is properly received, the DL850/DL850V enters into the Lock condition. Time acquisition and synchronization are possible after 1 s. A few minutes after the DL850/DL850V enters the Lock condition, it enters into the Stable condition. In the Stable condition, the internal clock of the DL850/DL850V is synchronized to within 10 ppm of the GPS.

Language (Language)

Sets the language that is used in the setup menu and messages.
The available languages vary depending on the DL850/DL850V model that you are using.

Adjusting the LCD (LCD)

You can turn off the LCD and adjust its brightness.

Adjusting the Brightness (Brightness)

You can adjust the brightness in the range of 1 (darkest) to 9 (brightest). You can prolong the LCD service life by decreasing the LCD brightness or by turning off the LCD when you do not need to view it.

Turning Off the LCD (LCD Turn OFF)

You can turn off the LCD. When the LCD is off, you can turn it back on by pressing a key.

Automatically Turning Off the LCD (Auto OFF)

The LCD turns off automatically when there are no key operations for a given time period. The LCD turns back on when you press a key.

Formatting Storage Media (Storage Manager)

You can format storage media.

If you format a storage medium, all saved data is erased.

USB Keyboard Language (USB Keyboard)

Sets the USB keyboard language to English or Japanese. The USB keyboard can be used to enter file names, comments, etc.

USB Communication (USB Function)

You can specify the communication features that are used when you connect the DL850/DL850V to a PC through USB.

- TMC: You can use USB TMC (Test and Measurement Class) to control the DL850/DL850V from a PC. To remotely control the DL850/DL850V using communication commands through the USB port, select USBTMC and then carry out the following procedure.
  - Install YOKOGAWA USB TMC driver on your PC.
  - Do not use USB TMC drivers (or software) supplied by other companies.
- Storage: The connected PC can use the DL850/DL850V as a USB storage device.
  - There is no need to install the USB TMC driver into your PC.

- For information about how to obtain the YOKOGAWA USB TMC driver, contact your nearest YOKOGAWA dealer. You can also access the YOKOGAWA USB driver download webpage and download the driver (http://tmi.yokogawa.com/service-support/downloads/).
- When USB Function is set to Storage, only the internal hard disk of the DL850/DL850V can be used as a storage device. You cannot access the storage media connected to the USB ports of the DL850/DL850V.
- When you access the internal hard disk of the DL850/DL850V from a PC, only perform read, write, and delete operations. Otherwise, the DL850/DL850V may be damaged.
- When USB Function is set to Storage and files are being accessed, do not remove the USB cable or turn off the DL850/DL850V. Doing so may damage the DL850/DL850V.

Environment Settings (Preference)

Action Performed at Power On (Power On Action)

Setting Whether to Start Waveform Acquisition (Start)

Select whether to start waveform acquisition at power on (ON) or not (OFF).

Setting Whether to Turn the Action Function On or Off (Action)

Select whether to enable the action function at power on (ON) or not (OFF).

- ON: When the power is turned on, the action mode setting is the same as it was when the power was turned off.
- OFF: When the power is turned on, the action mode is off.

Logic Settings (Logic Setup)

Logic Channel Display Format (Numerical Format)

Choose whether to display the logic waveform values in the numeric monitor as binary (Bit) or hexadecimal (Hex) values.

Cursor Read Order (Cursor Order)

Choose the order that you want to read the bit data from logic input signals in.

- 1->8: Bit 1 to bit 8
- 8->1: Bit 8 to bit 1

Bit Data Display Order (Bit Order)

Choose the order that you want to display the bit data from logic input signals in.

- 1->8: Bit 1 to bit 8
- 8->1: Bit 8 to bit 1

Terminal Setup (Terminal Setup)

Enabling or Disabling the Remote High (STOP) Signal (Remote Stop)

Select whether to ignore (ON) the remote high (STOP) signal or not (OFF).

Trigger Output Signal (Trigger Out)

You can set the type of signal that is generated from the trigger output terminal to Normal or Pulse.

Trigger Output Signal Pulse Width (Pulse Width)

When you set the trigger output signal type to Pulse, you can set the pulse width to 1 ms, 50 ms, 100 ms, or 500 ms.

Configuring the Display (Display Setup)

Menu Font Size (Menu Font Size)

You can set the font size of the menu to Small or Large.

Menu Background Color (Base Color)

You can set the background color of the menu to Blue or Gray.

Scale Value Display Font Size (Scale Font Size)

You can set the font size of the scale value display to small or large.

Items Whose Scale Values Are Displayed (Scale On Item)

Set the items that you want to display when Scale Value is set to ON.

- ALL: The vertical axis (V Scale) and horizontal axis (Time Scale) are displayed.
- Time Scale: Only the horizontal axis (Time Scale) is displayed.

Turning the Level Indicator Display On and Off (Level Indicator)

You can choose whether to display the level indicator (ON), which shows the waveform levels, or not (OFF). The level indicator appears on the right side of the waveform display window.

Intensity (Intensity)

You can set the intensities of the grid (Grid), cursor (Cursor), and marker (Marker) to values within the range of 1 to 8.

Key and Knob Setup (Key/Knob Setup)

Turning On or Off the Click Sound (Click Sound)

You can turn on or off the click sound that is generated when you operate the jog shuttle.

START/STOP Key Response Time (START/STOP Response Time)

You can set the response time of the START/STOP key to instant (Quick) or 1 s or more (> 1sec).

Key Lock (Key Protect)

You can lock the operation keys to prevent unintentional changes to the current state of the DL850/DL850V.

- Type (Type)
  Select whether to lock all the keys (ALL) or to lock all keys except the START/STOP key (Except START/STOP).
- Release Method (Release Type)
  Select whether to release the key lock by pressing the KEY PROTECT key (Key) or by entering a password (Password).
- Password (Password)
  Specify the password to use to release the key lock. Specify the password using up to eight alphanumeric characters. If you forget the password, you can release the key lock by turning the DL850/DL850V on while holding down the RESET key. Note that all settings will be initialized when you do this.
  ▶ See here.

Self-Test (Selftest)

You can test the keyboard and memory operations.

Test Type (Type)

You can perform the following tests.

Key Test (Key Board)

Tests whether the front-panel keys are operating properly. If the name of the key that you press is highlighted, the key is operating properly.

Memory Test (Memory)

You can test the internal memory to determine whether it is functioning normally. If it is functioning normally, “Test Completed” appears. If an error occurs, “Failed” appears.

SD Memory Card Test (SD CARD)

You can test an SD memory card to determine whether it is functioning normally. If it is functioning normally, “Test Completed” appears. If an error occurs, “Failed” appears.

Hard Disk Test (HDD)

You can test an internal or external hard drive to determine whether it is functioning normally. If it is functioning normally, “Test Completed” appears. If an error occurs, “Failed” appears.

Printer Test (Printer)

Tests whether the optional built-in printer is operating properly. If the print density is correct, the built-in printer is operating properly. If an error occurs, the built-in printer does not print properly.

Update (Version Up)

Select this option to update the firmware. For details on updating firmware versions, contact your nearest YOKOGAWA dealer.

Executing a Test (Test Exec)

The selected self-test starts.

If an Error Occurs during a Self-Test

If an error occurs even after you carry out the following procedure, contact your nearest YOKOGAWA dealer.

- Execute the self-test again several times.
- Check whether the media being tested is properly inserted.
- Check that the paper is set properly in the built-in printer and that paper is not jammed.

Overview (Overview)

You can display the following information about the DL850/DL850V.

- Model
- Record Length
- Serial Number
- Product ID: Unique number assigned to each instrument. This number is necessary for the purchase of additional options.
- Slot: Names of the inserted modules
- Options
- Default Language
- Firm Version: Firmware version number
- FPGA1/2 Version: FPGA1/2 version number

* The 70126, 701280, and 720240 modules have internal CPUs and firmware. For slots that have these modules installed in them, the version number of the firmware installed on the module is also displayed.

- For the 701265
  Example: 701265 A.AA
  A.AA is the version of the firmware installed on the module.
- For the 701280 or 720240
  Example: 701280 B.BB/C.CC
  B.BB is the version of the firmware installed on the module. C.CC is the version of the firmware on the DL850/DL850V that can be installed on the 701280 (FREQ). If the two above versions are the same, only one version number will be displayed.

Key Lock (KEY PROTECT)

You can lock the operation keys to prevent unintentional changes to the current state of the DL850/DL850V. When the keys are locked, pressing any keys other than KEY PROTECT has no effect, and the USB mouse and keyboard cannot be used.

▶ See here.

NUM LOCK

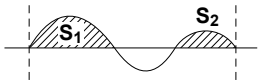
Press this key to use the CH1 to CH16 keys to enter numbers. After you press NUM LOCK, you can press a channel key to enter the number, sign, unit prefix, or exponent displayed to the upper right of the key in white, or to confirm an entry or selection (ENTER).

Appendix

Appendix 1 How to Calculate the Area of a Waveform

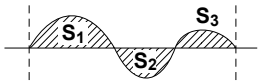
Integ1TY

Sum of only the positive curve areas : $S_1 + S_2$



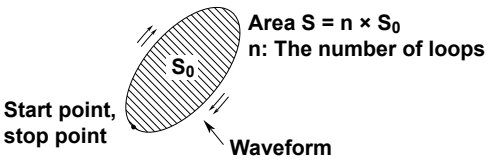
Integ2TY

Sum of the positive and negative curve areas: $S_1 + S_3 – S_2$

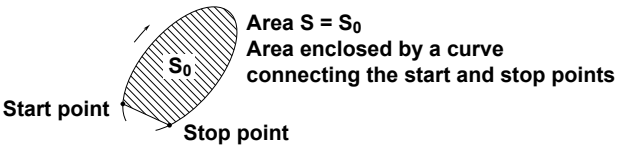


Integ1XY

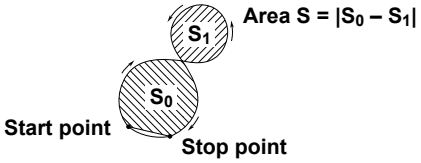
(1) Multiple Loops



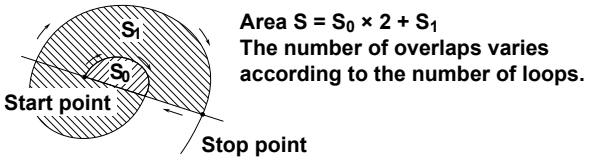
(2) Non-Closed Curve



(3) Loop Tracing a Figure-Eight



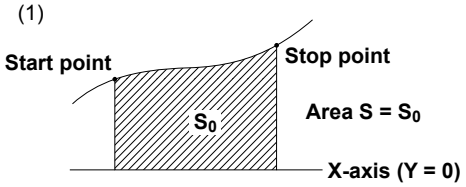
(4) Loop Tracing a Spiral



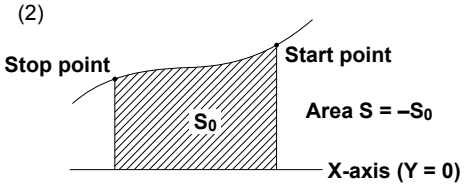
Integ2XY

(1) When Each Y Data Point Corresponds to a Single X Data Point

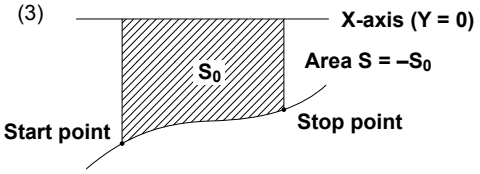
(1)



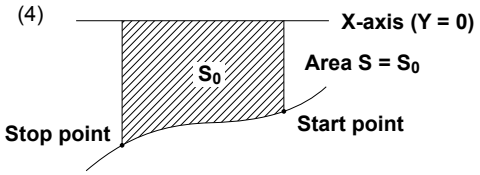
(2)



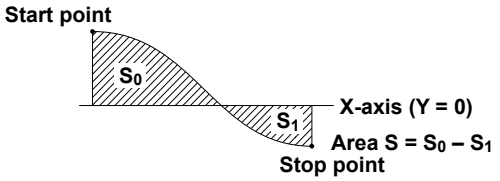
(3)



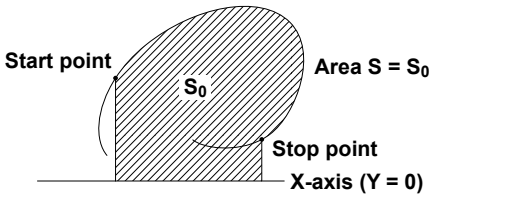
(4)

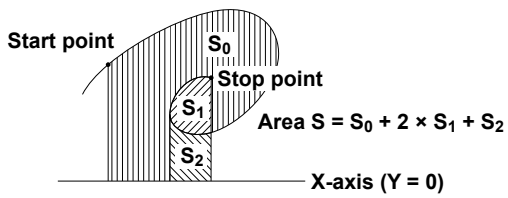


(2) When the Waveform Extends into the Negative Side



(3) When Multiple Y Data Corresponds to One Point of X Data





Appendix 2 User-Defined Computation (Optional)

Digital Filter

Type

Type	Bandwidth
Gauss (Gaussian)	LowPass
Sharp	LowPass/HighPass/BandPass
IIR (Butterworth)	LowPass/HighPass/BandPass

Filter Order

See the following table for the filter orders.

		2%	5%	10%	20%	30% (Cutoff)
Gauss	LowPass	49	21	9	5	5
Sharp	LowPass	88	36	18	9	8
	HighPass	159	65	33	17	13
IIR	LowPass	4	4	4	3	2
	HighPass	4	4	4	4	3

Filter Characteristics

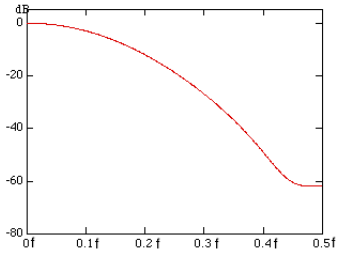
Filter	Pass-band Ripple	Attenuation Slope	Attenuation at the Stop-band	Phase
Gauss	0 dB	*	–	Linear phase
Sharp	±0.3 dB	−40 dB at 1 oct (Lowpass),	−40 dB	Linear phase
		−40 dB at −1 oct (Highpass)	–	Linear phase
IIR	0 dB	−5 dB at 1/6 oct (Lowpass),	–	Non-linear
		−20 dB at −1 oct (Highpass)	–	phase

* For Gaussian filter: $-3.0 \times (f/fc)^2$ dB (f: frequency, fc: cutoff frequency)

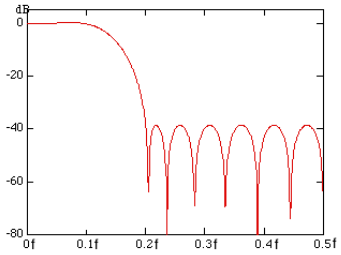
Frequency Characteristics of Filters

f: Sampling frequency (Hz)

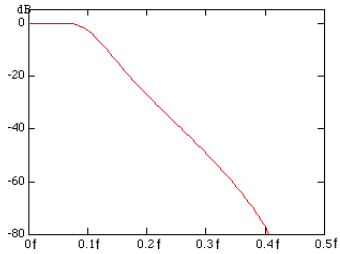
Gauss (10% cutoff)



Sharp (Low pass; 10% cutoff)



IIR (Low pass; 10% cutoff)



The higher the filter order the longer it takes for computation.

Hilbert Function (HLBT)

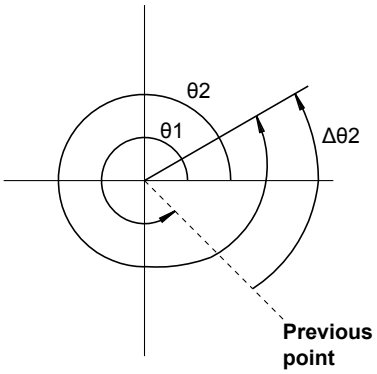
Normally, when we analyze real-time signals, it is useful to think of these signals as the real part of functions of complex variables, and to carry out the actual signal analysis using such functions.
If the real-time signal is considered to be the real part of the function, the imaginary part can be determined with the Hilbert transform of the real part.
The Hilbert transform does not change the order of the individual variables. The Hilbert transform of a time signal results in another time signal.
The Hilbert transform procedure is as follows.
When a time-domain signal is transformed, the signal is first transformed into the frequency domain through Fourier transform. Next, the phase of each frequency component is shifted by −90 degrees if the frequency is positive and +90 degrees if the frequency is negative. Lastly, taking the inverse Fourier transform completes the Hilbert transform.

Example

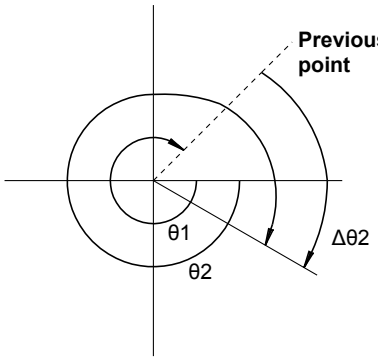
- The Hilbert transform can be used to analyze an envelope waveform.
  AM (amplitude modulation): SQRT(C1 × C1 + HLBT(C1) × HLBT(C1))
  Demodulation of an FM Signal: DIF(PH(C1, HLBT(C1)))

Phase Function (PH)

Phase function PH(X1, Y1) computes $\tan^{-1}$(X1/Y1).
The phase function takes the phase of the previous point into consideration and continues to sum even when the value exceeds ±π (the ATAN function reflects at ±π).
The unit is radians.



θ2 = θ1 + Δθ2

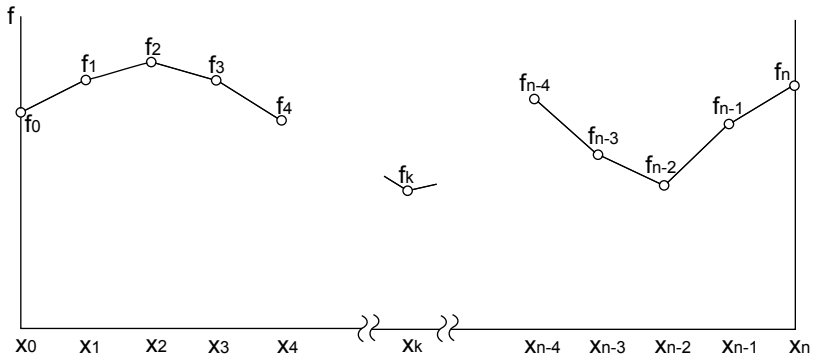


θ2 = θ1 – Δθ2

Differentiation and Integration (DIF, DDIF, INTG, and IINTG)

Differentiation (DIF, DDIF)

The computation of the first-order and second-order differentiated values uses the 5th order Lagrange interpolation formula to derive a point of data from the five points of data before and after the target.
The figure below shows data f0 to fn with respect to sampling times x0 to xn. The derivative and integrated values corresponding to these data points are computed as shown below.



- Equations for First Order Derivatives

Point x_0 f_0' = $\frac{1}{12h}[-25f_0 + 48f_1 - 36f_2 + 16f_3 - 3f_4]$

Point x_1 f_1' = $\frac{1}{12h}[-3f_0 - 10f_1 + 18f_2 - 6f_3 + f_4]$

Point x_2 f_2' = $\frac{1}{12h}[f_0 - 8f_1 + 8f_3 - f_4]$

Point x_k f_k' = $\frac{1}{12h}[f_{k-2} - 8f_{k-1} + 8f_{k+1} - f_{k+2}]$

Point x_{n-2} f_{n-2}' = $\frac{1}{12h}[f_{n-4} - 8f_{n-3} + 8f_{n-1} - f_n]$

Point x_{n-1} f_{n-1}' = $\frac{1}{12h}[-f_{n-4} + 6f_{n-3} - 18f_{n-2} + 10f_{n-1} + 3f_n]$

Point x_n f_n' = $\frac{1}{12h}[3f_{n-4} - 16f_{n-3} + 36f_{n-2} - 48f_{n-1} + 25f_n]$

h = Δx is the sampling interval (s) (example: h = 200 × 10^{-6} at 5 kHz)

- Equations for Second Order Derivatives (DDIF)

Point x_0 f_0'' = $\frac{1}{12h^2}[35f_0 - 104f_1 + 114f_2 - 56f_3 + 11f_4]$

Point x_1 f_1'' = $\frac{1}{12h^2}[11f_0 - 20f_1 + 6f_2 + 4f_3 - f_4]$

Point x_2 f_2'' = $\frac{1}{12h^2}[-f_0 + 16f_1 - 30f_2 + 16f_3 - f_4]$

Point x_k f_k'' = $\frac{1}{12h^2}[-f_{k-2} + 16f_{k-1} - 30f_k + 16f_{k+1} - f_{k+2}]$

Point x_{n-2} f_{n-2}'' = $\frac{1}{12h^2}[-f_{n-4} + 16f_{n-3} - 30f_{n-2} + 16f_{n-1} - f_n]$

Point x_{n-1} f_{n-1}'' = $\frac{1}{12h^2}[-f_{n-4} + 4f_{n-3} + 6f_{n-2} - 20f_{n-1} + 11f_n]$

Point x_n f_n'' = $\frac{1}{12h^2}[11f_{n-4} - 56f_{n-3} + 114_{n-2} - 104f_{n-1} + 35f_n]$

Integration (INTG, IINTG)

The first and second order integrated values are derived using the trapezoidal rule.

- Equations for First Order Integration (INTG)

  Point x_0 $I_0 = 0$

  Point x_1 $I_1 = \frac{1}{2}(f_0 + f_1)h$

  Point x_2 $I_2 = \frac{1}{2}(f_0 + f_1)h + \frac{1}{2}(f_1 + f_2)h = I_1 + \frac{1}{2}(f_I + I_2)h$

  Point x_n $I_n = I_{n-1} + \frac{1}{2}(f_{n-1} + f_n)h$

- Equations for Second Order Integration (IINTG)

  Point x_0 $II_0 = 0$

  Point x_1 $II_1 = \frac{1}{2}(I_0 + I_1)h$

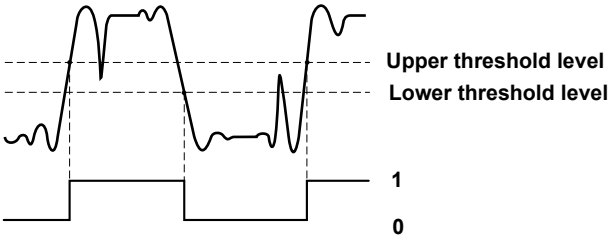
  Point x_2 $II_2 = \frac{1}{2}(I_0 + I_1)h + \frac{1}{2}(I_1 + I_2)h = II_1 + \frac{1}{2}(I_I + I_2)h$

  Point x_n $II_n = II_{n-1} + \frac{1}{2}(I_{n-1} + I_n)h$

Binary Conversion (BIN)

Binary conversion is performed through the use of the specified threshold levels.

BIN(C1)



Pulse Width Computation

The signal is converted to binary values according to the preset threshold levels, and the time of the pulse width is plotted as the Y-axis value for that interval.

You can set the interval to one of the four settings below.

PWHH From a rising edge to the next rising edge.

PWHL From a rising edge to the next falling edge.

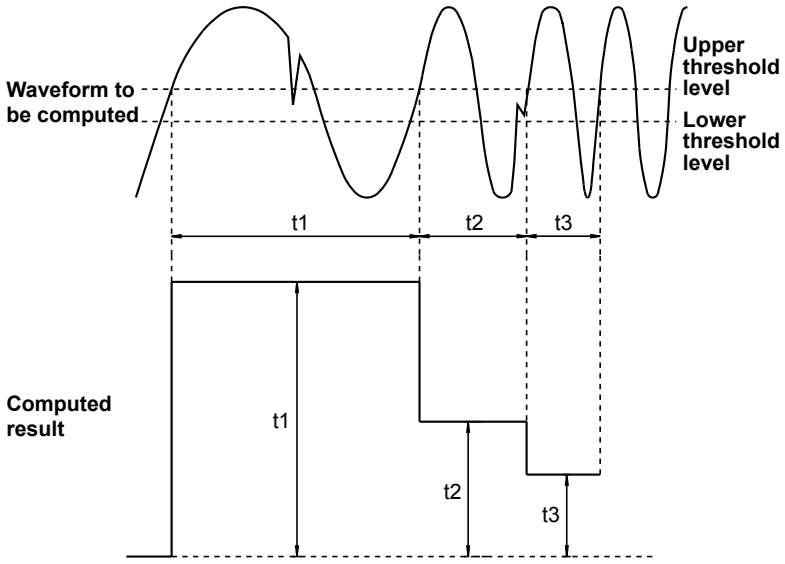
PWLH From a falling edge to the next rising edge.

PWLL From a falling edge to the next falling edge.

PWXX From a rising or falling edge to the next rising or falling edge.

FV Inverse of PWHH

Example for PWHH



FFT Function - user-defined

Each frequency component G of a linear spectrum is represented by G = R + jI, where R is the real part and I is the imaginary part.

Linear Spectrum

The linear spectrum can be directly determined with the FFT. Through this spectrum, the magnitude and phase of each frequency component included in the measured waveform can be found. The power spectrum and cross spectrum can also be determined from the linear spectrums of one or two signals.

Because the FFT is a complex function, the linear spectrum produces the real part and imaginary part of the frequency components. The magnitude and phase of the linear spectrum can also be determined from this result.

The DL850/DL850V can determine the following spectrums.

Item	Expression	Computation
Real part	LS-REAL	R
Imaginary part	LS-IMAG	I
Magnitude	LS-MAG	$\sqrt{(R^2+I^2)}$
Log magnitude	LS-LOGMAG	$20 \times \log \sqrt{(R^2+I^2)}$
Phase	LS-PHASE	$\tan^{-1}(I/R)$

Log magnitude reference (0 dB): 1 Vpeak

Power Spectrum

The power spectrum expresses the power (squared value) of each frequency component included in the measured signal. It is determined by taking the product of the linear spectrum and its complex conjugate. It does not contain phase information.
The DL850/DL850V can determine the following spectrums.

Item	Expression	Computation
Magnitude	PS-MAG	DC component $R^2 + I^2$
		AC component $(R^2 + I^2)/2$
Log magnitude	PS-LOGMAG	DC component $10 \times \log(R^2 + I^2)$
		AC component $10 \times \log\{(R^2 + I^2)/2\}$

Log magnitude reference (0 dB): 1 $Vrms^2$

Power Spectrum Density

The power spectrum density expresses the power spectrum per unit frequency. It is determined by dividing the power spectrum by the frequency resolution Δf found during the analysis of the power spectrum. The computation varies depending on the window function.
Power spectrum density is used to compare power spectrums analyzed at different frequency bands. However, it is not necessary for signals having a line spectrum such as sine waves.
The DL850/DL850V can determine the following spectrums.

Item	Expression	Computation
Magnitude	PSD-MAG	PS-MAG/(Δf × k)
Log magnitude	PSD-LOGMAG	10 × logPS-MAG/(Δf × k)

Log magnitude reference (0 dB): 1 $Vrms^2$

Overall Value

The overall value is the total RMS value determined from the frequency spectrum included in the signal. The overall value is the square root of the summation of the power spectrums of all frequencies.

$$\text{Overall value} = \sqrt{\frac{2 \times PS_0 + \Sigma PS_i}{k}} \ \text{(Vrms)}$$

“Rms = overall value” appears on the screen when automated measurement of waveform parameters is being performed (MEASURE is set to ON) on the channel that has been selected for power spectrum computation (PS or PSD) and Rms is set to ON.
However, when Window is set to Exponential, overall values are not displayed.

k

k varies as indicated below depending on the selected time window.

Time Window Type	k
Rect (rectangular window)	1
Hanning (hanning window)	1.5
FlatTop (flattop window)	3.19693
Hamming (hamming window)	1.3628

Cross Spectrum

The cross spectrum is determined from two signals. It is the product of the linear spectrum of one signal (Gy) and the complex conjugate (Gx^*) of the linear spectrum of the other signal (Gx).
If the linear spectrums of the two signals are represented by

$Gx = Rx + jIx$

$Gy = Ry + jIy$

then the cross spectrum Gyx is

$Gyx = Gy \times Gx^*$

$= (Ry + jIy)(Rx - jIx) = Ryx + jIyx$

where $Ryx = RyRx + IyIx$

$Iyx = RxIy - RyIx$

The DL850/DL850V can determine the following spectrums.

Item	Expression	Computation
Real part	CS-REAL	Ryx/2
Imaginary part	CS-IMAG	Iyx/2
Magnitude	CS-MAG	$\sqrt{(Ryx^2+Iyx^2)/2}$
Log magnitude	CS-LOGMAG	$10 \times \log (\sqrt{(Ryx^2+Iyx^2)/2})$
Phase	CS-PHASE	$\tan^{-1}(Iyx/Ryx)$

Transfer Function

The transfer function expresses the frequency responses of the input to and the output from the transfer system. The transfer function is determined by the ratio of the output linear spectrum (Gy) and the input spectrum (Gx) at each frequency. Also, as can be seen from the following equation, the transfer function can be defined as the ratio of the cross spectrum of the input and output (Gyx) and the input power spectrum (Gxx).

Transfer function = $Gy/Gx = (Gy \times Gx^*)/(Gx \times Gx^*) = Gyx/Gxx$

$= (Ryx + jIyx)/(Rx2 + Ix2)$

The DL850/DL850V can determine the following items.

Item	Expression	Computation
Real part	TF-REAL	$Ryx/(Rx^2 + Ix^2)$
Imaginary part	TF-IMAG	$Iyx/(Rx^2 + Ix^2)$
Magnitude	TF-MAG	$\sqrt{(Ryx^2+Iyx^2)}/(Rx^2 + Ix^2)$
Log magnitude	TF-LOGMAG	$20 \times \log\sqrt{(Ryx^2+Iyx^2)}/(Rx^2 + Ix^2)$
Phase	TF-PHASE	$\tan^{-1}(Iyx/Ryx)$

The magnitude of the transfer function shows the ratio of the magnitudes of the output linear spectrum and the input linear spectrum while the phase shows the phase difference of the two.

Coherence Function

The coherence function expresses the ratio of the output power generated by the input signal to the transfer system and the total output power.

Coherence function = $Gyx \times Gyx^*/(Gxx \times Gyy)$

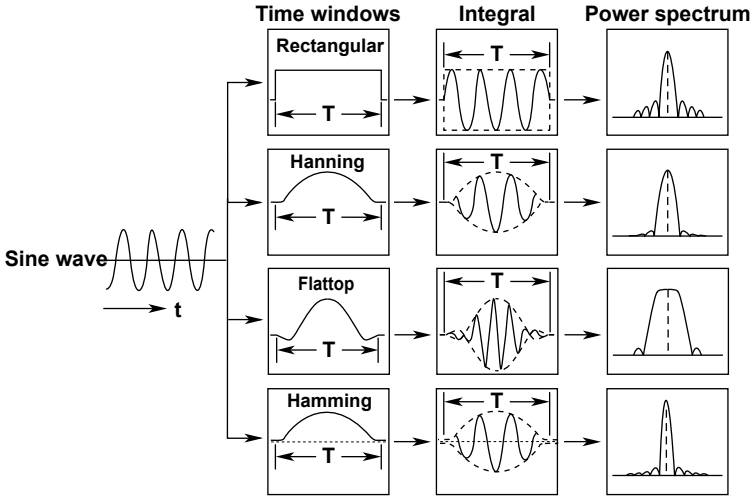
Item	Expression	Computation
Phase	CH-MAG	$\tan^{-1}(Ryx^2 + Iyx^2)/(Gxx \times Gyy)$

If the output signal is due entirely to the input signal, the coherence function becomes 1. As the ratio decreases, it falls below 1. Thus, the coherence function always takes on a value between 0 and 1.

On one data acquisition, the coherence function becomes 1 across all frequencies. Make sure to take the frequency average of the computation.

Time Windows

You can use a rectangular, Hanning, flattop, or exponential time window (you can only use an exponential time window on models with the user-defined computation option).
The rectangular window is suited to transient signals, such as impulse waves, which attenuate completely within the time window. The Hanning and flattop windows allow continuity of the signal by gradually attenuating the parts of the signal located near the ends of the time window down to the 0 level. Hence, they are suited to continuous signals. The Hanning window provides a higher frequency resolution compared to the flattop window. However, the flattop window has a higher level of accuracy. When the waveform being analyzed is a continuous signal, consider the above characteristics in selecting the proper window to be applied.



Rectangular : $W(t) = u(t) - u(t - T)$ u(t): **Step function**

Hanning : $W(t) = 0.5 - 0.5 \cos(2\pi \frac{t}{T})$

Flattop : $W(t) = \{0.54 - 0.46 \cos(2\pi \frac{t}{T})\} \frac{\sin\{2\pi(1 - 2t/T)\}}{2\pi(1 - 2t/T)}$

Hamming : $W(t) = 0.54 - 0.46 \cos(2\pi \frac{t}{T})$

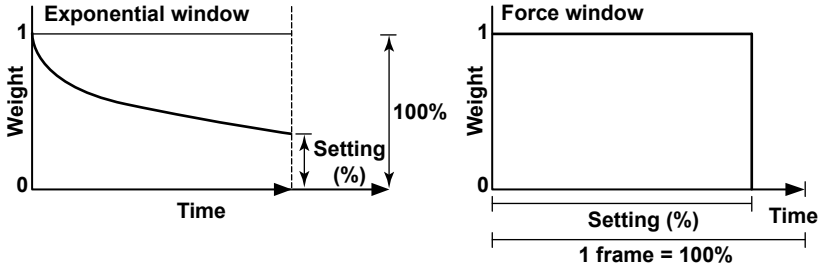
The exponential window is used to eliminate noise components from the signal. It is suited for the signals of impulse-excitation frequency-response tests and other similar signals. On the DL850/DL850V, the exponential window and force window are activated simultaneously.

Exponential Window

The damping rate is set in terms of the weight of the last data point, with the weight of the first data point in the specified number of FFT points taken to be 100% (= 1). You can set the damping rate in the range of 1 to 100% (1% resolution). The exponential window damps the signal exponentially along the time axis. It is effective when the signal does not attenuate fully within the record length. When the damping rate is set to 100%, the window functions like a rectangular window.

Force Window

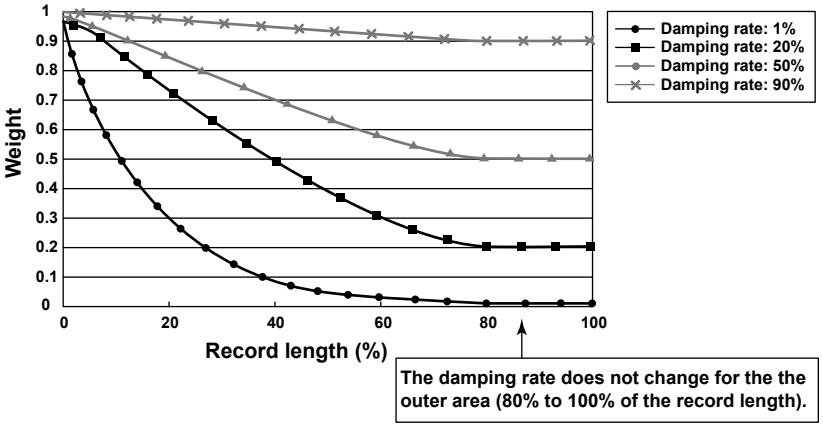
Set the area over which computation is performed in terms of a percentage from the first FFT point, taking the set number of FFT points to be 100%. The areas (force 1 and force 2) can be set in the range of 1 to 100% (1% resolution) of the input/output signal. When an area is set to 100%, the window functions like a rectangular window. On the DL850/DL850V, the outer area is the average of the results of the window function for the data outside the area.
Force1: This setting applies to the input signals of one-waveform and two-waveform FFTs.
Force2: This setting applies to the output (response) signal (second parameter) of a two-waveform FFT.



Combined Form of the Exponential and Force Windows

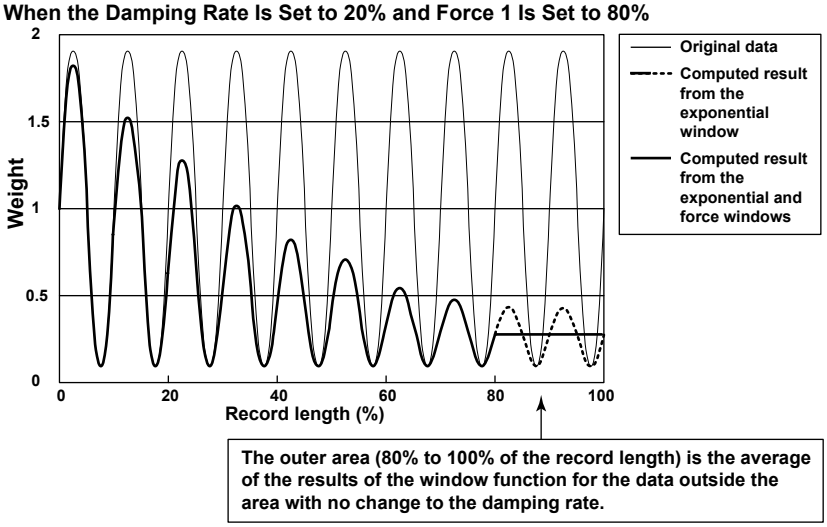
The DL850/DL850V uses a window function that combines the exponential window and force window to perform computations. The outer area of the force window is the average of the results of the window function for the data outside the area.

When the Force Window Area Is Set to 80% and the Data Outside the Area Is Taken into Account


Damping rate: 1%
Damping rate: 20%
Damping rate: 50%
Damping rate: 90%
Weight
Record length (%)
The damping rate does not change for the the outer area (80% to 100% of the record length).

- Application Example on the DL850/DL850V

When the Damping Rate Is Set to 20% and Force 1 Is Set to 80%


Original data
Computed result from the exponential window
Computed result from the exponential and force windows
Weight
Record length (%)
The outer area (80% to 100% of the record length) is the average of the results of the window function for the data outside the area with no change to the damping rate.

Notes about Executing FFT Computation

Computation is normally performed on the sampled data in the acquisition memory. However, for waveforms that have been acquired in envelope mode, computation is performed on the maximum and minimum values per acquisition interval.

Appendix 3 Fundamental Equations for Defining Strain

Definition of Strain

ΔL/L = ε .....(1)

ε: Strain
L: Initial length of the material
ΔL: Amount of change due to external strain

Definition of the Gauge Factor

Gauge factor (K) refers to the ratio between the mechanical strain and the change in the resistance of the strain gauge resistor.

$$\varepsilon = \frac{\Delta L}{L} = \frac{\Delta R/R}{K} \quad \text{.....(2)}$$

$$(\Delta R/R) = K \times \varepsilon \quad \text{.....(3)}$$

R: Gauge resistance
ΔR: Amount of change in resistance when strain is applied

Normally, K = 2.0. However, the value varies depending on the strain gauge material.

General Equation for the Measured Voltage (V) and Strain (ε) of a Wheatstone Bridge (1 Gauge Method)

If we assume V to be the voltage measured on the bridge and E to be the voltage applied to the bridge,
V = (1/4) × E × (ΔR/R) .....(4)

From equation (3),
(ΔR/R) = K × ε

Thus, V = (1/4) × E × K × ε .....(5)

When Determining the Strain (e) from the Measured Voltage (V) (Using a Strain Gauge and the 1 Gauge Method)

If we derive e from equation (5)
ε = (4/K) × (V/E) .....(6)

When Determining the Measured Value of the Strain Gauge Sensor (e) from the Voltage Measured on the Bridge (V) (Strain Gauge Sensor)

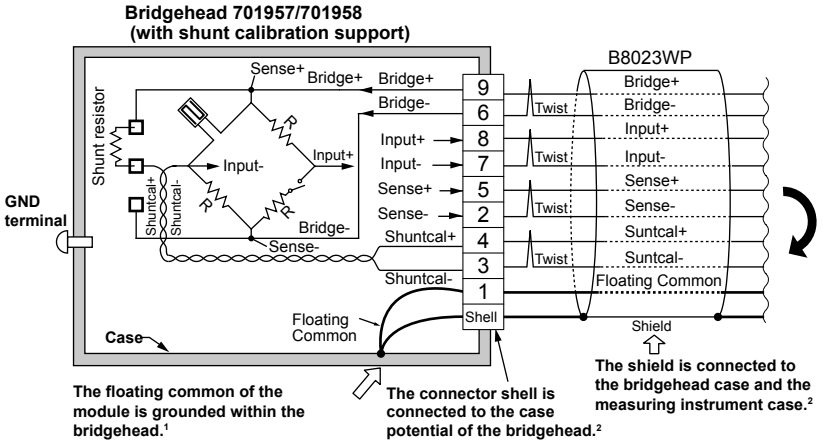
Assuming e to be the measured value (measured value of the strain gauge sensor: mV/V unit) and substituting ε = e in equation (6),
e = (4/K) × (V/E) .....(7)

In the case of a strain gauge sensor, set the gauge factor (K) to 2 on the DL850/DL850V. If you change the value of K, the values are converted through the use of the above equation.

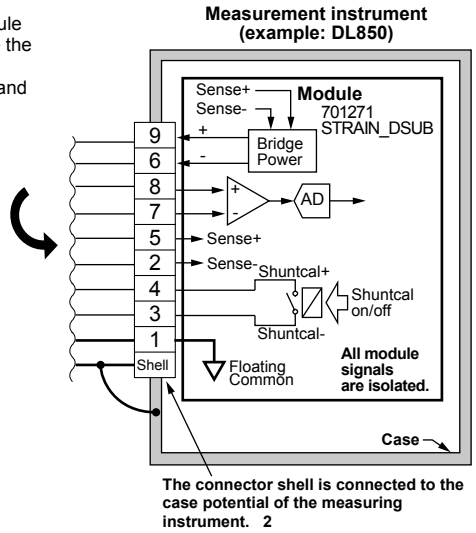
Appendix 4 Shunt Calibration of the Strain Module

In shunt calibration, the strain measurement gain is adjusted through the connection of a known resistance (the resistance for shunt calibration, hereinafter referred to as the shunt resistance) in parallel to the strain gauge. The strain module (701271 (STRAIN_DSUB)) supports shunt calibration with a built-in shunt-calibration relay circuit.

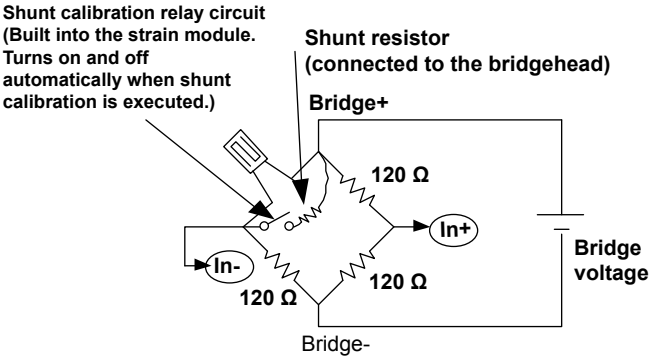
To perform shunt calibration, you need a bridgehead that supports shunt calibration (701957 or 701958).



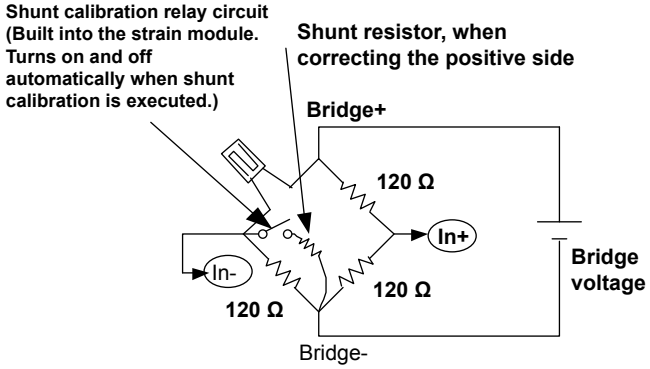
1 The GND (floating common) of the module is connected to the case potential inside the bridge box.
2 The bridgehead case, the cable shield, and the measuring instrument case are connected as measures against noise.



- **When correcting the gain on the negative side (normal)**



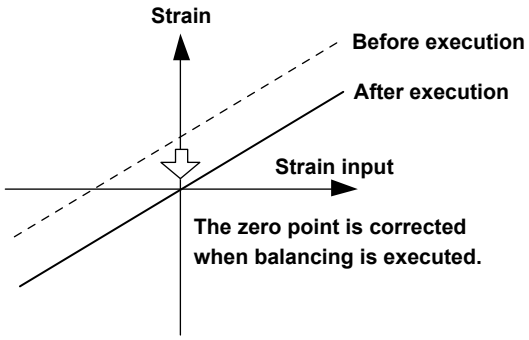
• **When correcting the gain on the positive side**



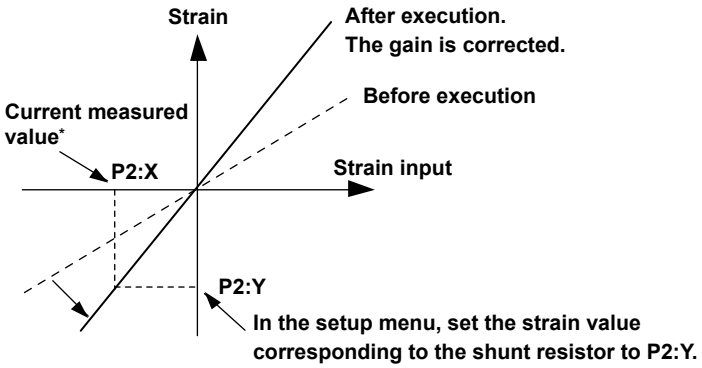
Shunt Calibration Procedure

1. Calculate the strain value (μSTR) that corresponds to the shunt resistor you will use. For the calculation procedure, see “Calculating the Shunt Resistance” in the next section.
2. Execute balancing without applying a load to the strain gauge, and correct the zero point.
3. Execute shunt calibration, and correct the gain.
   To execute shunt calibration, in the CH menu, select Linear Scale, Mode, and then Shunt. Usually, the negative gain is corrected. However, if you are correcting the positive gain, change the position of the shunt resistor as shown in the above figure.

• **Balance**



• **Shunt calibration**



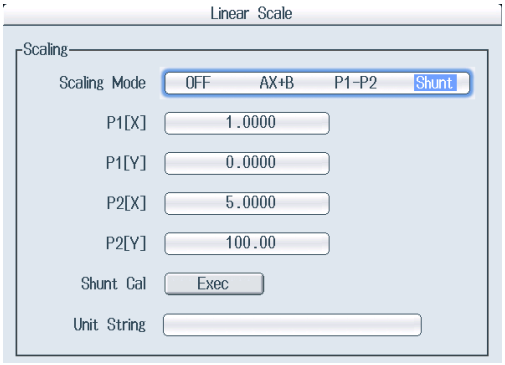
*** Obtained automatically when shunt calibration is performed**

Shunt Calibration Execution Menu

The shunt calibration execution menu appears when you select Linear Scale, Mode, and then Shunt in the CH menu. In normal shunt calibration, only P2:Y is set. On the DL850/DL850V, in addition to performing normal shunt calibration (when the shunt-calibration relay circuit is on), you can also set the zero-point value when the relay circuit is off. The zero-point value is valid when the strain value after balancing is performed is not 0.

Items in the Execution Menu

(1) P1[X]: When shunt calibration is executed, the input value when the relay circuit is off is applied.
(2) P1[Y]: Set the value for when the relay circuit is off (normally 0).
(3) P2[X]: When shunt calibration is executed, the input value when the relay circuit is on is applied.
(4) P2[Y]: Set the strain value that corresponds to the shunt resistance when the relay circuit is on.



- When you execute shunt calibration, select an appropriate range so that the measured values will stay within the range when the shunt-calibration relay circuit is on. The DL850/DL850V attempts to perform shunt calibration within the current range.
- An error message will appear if shunt calibration fails (because of out-of-range values or some other reason). When this happens, change the range, and perform shunt calibration again.
- Do not connect and disconnect multiple USB devices repetitively. Provide a 10-second interval between removal and connection.

Reducing Noise

Because measurements are made at the mV level, the strain gauge is extremely susceptible to noise. If the execution of balancing or shunt calibration fails, it may be due to noise. Please take the following points into consideration.

- Because the strain gauge is attached away from the bridgehead, we recommend that you use twisted wire for extensions.
- Use a bridgehead with high noise resistance. We recommended that you use a YOKOGAWA bridgehead (701957 or 701958); they are highly resistant to noise.

Calculation of the Shunt Resistance

To execute shunt calibration, you need to calculate the shunt resistance (Rs) and the expected strain (ε) in advance. For “P2-Y,” use ε as given in the equation below (normally a negative value).
In the general method given for shunt calibration (the easy method), an error of 1 to 2% is introduced as the strain value (ε) increases. Therefore, use the detailed method whenever possible.

Equation for Rs and ε When Shunt Calibration Is Executed

General Equation (Easy method)

$\Delta R/R = K \times \varepsilon$.....(1): Fundamental strain equation

$\Delta R = R - R//Rs^{*}$.....(2): Equation for the change in resistance when the shunt resistance is on

* In this manual, the equation for parallel resistances is expressed as follows:

$$R//Rs = \frac{1}{\frac{1}{R} + \frac{1}{Rs}} = \frac{R \times Rs}{R + Rs}$$

If ΔR from (1) and (2) is cancelled out,

$Rs = R \times (1 - K \times \varepsilon)/(K \times \varepsilon)$
Equation A: General equation for calculating the shunt resistance (includes error)

- **ε: Strain (strain value that you want to be generated when the shunt resistance is turned on)**
- **K: Gauge factor**
- **R: Bridge resistance**
- **ΔR: Resistance change**
- **Rs: Shunt resistance (shunt resistance you want to derive)**

Detailed Equation

$V0 = E \times (R_1 \times R_3 - R_2 \times R_4)/\{(R_1 + R_2) \times (R_3 + R_4)\}$

.....(1): Basic equation for a Wheatstone bridge

When shunt calibration is on,

$V0 = E \times (R_1 \times R_3 - R' \times R_4)/\{(R_1 + R') \times (R_3 + R_4)\}$

.....(2): Equation when shunt calibration is on

$R' = R_2//Rs$ .....(3): Equation for combined resistance R'

$R_1 = R_2 = R_3 = R_4 = R$.....(4): Since R_1 to R_4 are equal, they are represented as R.

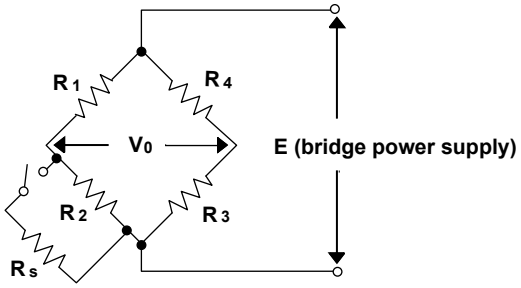
Also, from the basic equation of strain,

$V0/E = K \times \varepsilon/4$.....(5): Basic equation of strain

If V0/E and R_1 to R_4 from (2), (3), (4), and (5) are cancelled out,

$Rs = R \times (1 - K \times \varepsilon/2)/(K \times \varepsilon)$	**Equation B: Detailed equation for calculating the shunt resistance (no error)**

E: Bridge voltage
V_0: Bridge output voltage
R_1 to R_4: Bridge resistance ($R_1 = R_2 = R_3 = R_4$)
Rs: Shunt resistance (shunt resistance you want to derive)
R': Combined resistance when the relay is turned on (R' = R//Rs)



Calculation Example

When Determining the Shunt Resistance (Rs) from the Strain (ε)

Given a gauge factor (K) of 2,

Detailed equation (equation B) $Rs = R \times (1 - \varepsilon)/(2 \times \varepsilon)$.....(6)

General equation (equation A) $Rs = R \times (1 - 2 \times \varepsilon)/(2 \times \varepsilon)$.....(7) Degree of error of 1 to 2%

Desired Strain	Rs Value (Ω) Derived from the Detailed Equation (6)		Rs Value (Ω) Derived from the General Equation (7)	
ε (μSTR)	R = 120 Ω	R = 350 Ω	R = 120 Ω	R = 350 Ω
1,000	59,940	174,825	59,880	174,650
2,000	29,940	87,325	29,880	87,150
5,000	11,940	34,825	11,880	34,650
10,000	5,940	17,325	5,880	17,150

When Determining the Strain (ε) from the Shunt Resistance (Rs)

If we derive ε from equations (6) and (7),

Detailed equation (equation B) $\varepsilon = 1/(1 + 2 \times Rs/R)$.....(8)

General equation (equation A) $\varepsilon = 1/\{2 \times (1 + Rs/R)\}$.....(9) Degree of error of 1 to 2%

- When the Bridge Resistance R is 120 Ω

RS Value (Ω)	Strain ε (μSTR) Derived from the Detailed Equation (8)	Strain ε (μSTR) Derived from the General Equation (9)
60,000	999	998
30,000	1,996	1,992
12,000	4,975	4,950
6,000	9,901	9,804

- When the Bridge Resistance R is 350 Ω

RS Value (Ω)	Strain ε (μSTR) Derived from the Detailed Equation (8)	Strain ε (μSTR) Derived from the General Equation (9)
180,000	971	970
90,000	1,941	1,937
36,000	4,838	4,814
18,000	9,629	9,537

Appendix 5 Measurement Principle of the Frequency Module

Measurement Principle (Measurement Method and Update Rate) of the Frequency Module

The measurement principle of the period, frequency, pulse width, and duty cycle on the frequency module (701280 (FREQ)) is described below.

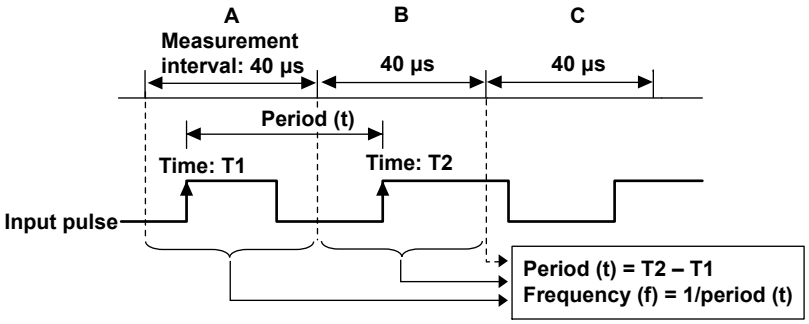
Period and Frequency Measurement

The frequency module updates the waveform at a rate of 25 kHz (40 µs interval). The measurement method differs for frequencies above 25 kHz and below 25 kHz as described below.

- When the input signal is less than or equal to 25 kHz, measurement is made as described in (1).
- When the input signal is greater than or equal to 25 kHz, measurement is made as described in (2).
- The sequence of processing described below is performed simultaneously through pipeline processing. Thus, the period (t) and frequency (f) are updated every 40 µs.

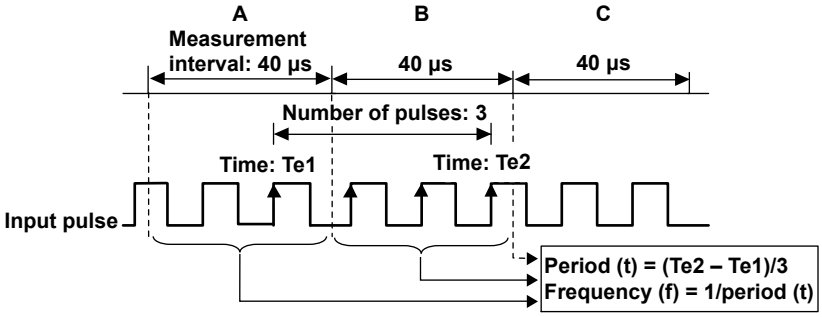
(1) When the input signal is less than or equal to 25 kHz

The module measures the time of occurrence of the pulse edge (T1) in measurement interval A.
The module measures the time of occurrence of the pulse edge (T2) in measurement interval B.
The module calculates the period (t) in measurement interval C. t = T2 − T1
The frequency (f) is calculated as 1/period (t).
When the period of the input pulse spans over multiple measurement intervals, computation is performed in the measurement interval following the interval in which the edge is detected.



(2) When the input signal is greater than or equal to 25 kHz

The module measures the time of occurrence of the last pulse edge (Te1) in measurement interval A.
The module measures the time of occurrence of the last pulse edge (Te2) in measurement interval B.
The module measures the number of pulses between the last pulse edge in measurement interval A and the last pulse edge in measurement interval B.
The module calculates the period (t) in measurement interval C. t = Te2 − Te1/number of pulses
The period (t) calculated is the average value of multiple pulses.
The frequency (f) is calculated as 1/period (t).
If the input pulse period is short, the DL850/DL850V automatically takes the average of multiple pulses and calculates the period and frequency. Therefore, the resolution does not degrade even when the input pulse period is short, and highly accurate measurement is possible.



Pulse Width and Duty Cycle Measurement

- When the input signal is less than or equal to 25 kHz, measurement is made as described in (1).
- When the input signal is greater than or equal to 25 kHz, measurement is made according to the last waveforms in the measurement intervals as described in (2).
- The sequence of processing described below is performed simultaneously through pipeline processing. Thus, the period (t) and frequency (f) are updated every 40 µs.

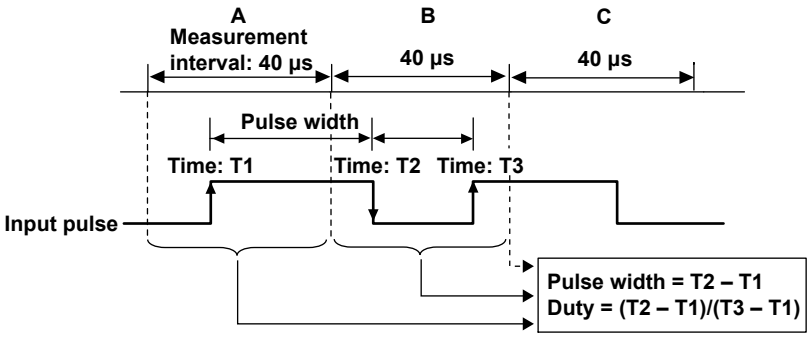
(1) When the input signal is less than or equal to 25 kHz

The module measures the times of occurrence of the pulse edges (T1, T2, and T3) in measurement intervals A and B.

In measurement interval C:

For the pulse width: The module calculates the pulse width as T2 − T1.

For the duty cycle: The module calculates the duty cycle as (T2 − T1)/(T3 − T1).



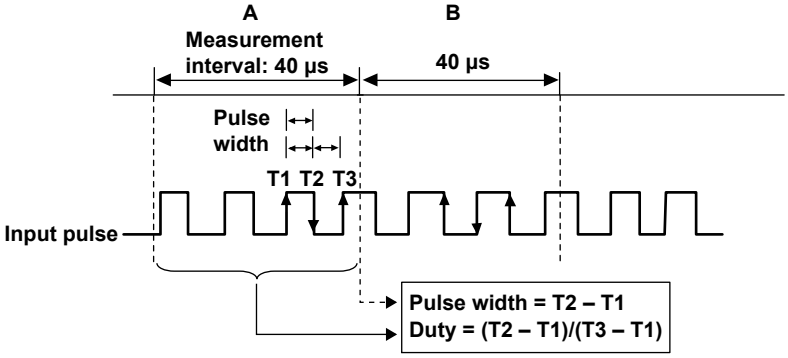
(2) When the input signal is greater than or equal to 25 kHz

The DL850/DL850V measures the times of occurrence of the last pulse edges (T1, T2, and T3) in measurement interval A.

In measurement interval B:

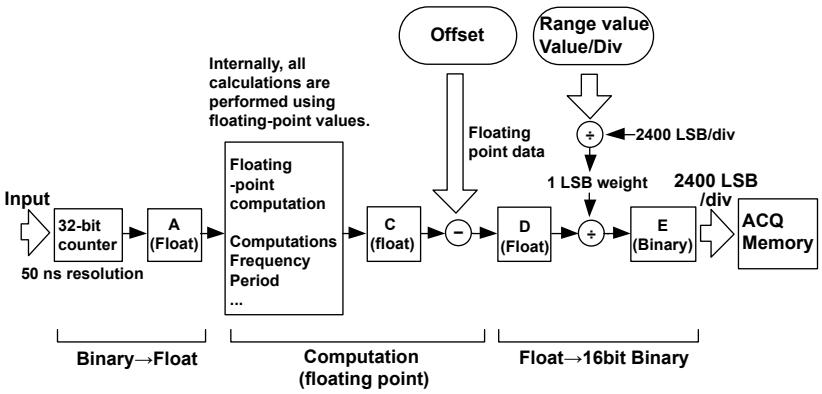
For the pulse width: The module calculates the pulse width as T2 − T1.

For the duty cycle: The module calculates the duty cycle as (T2 − T1)/(T3 − T1).



Computation Format (Resolution) of the Frequency Module

The computation flow on the frequency module is indicated below.



The frequency module measures the period of the input signal using a 32-bit counter at a resolution of 50 ns. Therefore, the minimum resolution of the counter values is 50 ns.
Computations are performed in floating point format. The data that is output from the frequency module and written to the acquisition memory (ACQ Memory) is 16-bit binary data. The frequency module converts the data using a weight of 1 LSB that is determined by Value/div. The data is normalized to 2400 LSB/div when displayed on the screen.

Input: Conversion from 32-bit Counter Values to Floating Point Values

The frequency module converts the count value that it obtains using the 32-bit counter at 50 ns resolution to floating point format, and determines period A using the following equation.
Period: A (Float) = (Count value) × 50 ns

Computation

Various computations are performed in floating point format based on the settings.
Example Frequency: C (float) = 1/A (float)

Calculation of the 1 LSB Weight of the Output

The 1 LSB weight of the output is determined from the range (value/div).
Because 1 div = 2400 LSB,
1 LSB weight of the output = (Value/div)/2400

Computation Output: Conversion from Floating Point Values to 16-bit Binary Values (When the Offset Is 0)

When the offset value is 0, offset calculation is not performed, and C (float) = D (float).
The data is converted into 16-bit binary data and written to the acquisition memory (ACQ Memory).
16-bit binary data: E (binary) = D (float) ÷ (1 LSB weight of the output)

Offset Computation

When the offset value is not 0, the frequency module computes the offset value in floating point format using the following equation and then converts the value to 16-bit binary data.
D (float) = C (float) − offset value (float)
In offset computation, if the computed result C (float) is equal to the offset value, the output is 0. If the computed result C (float) is less than the offset value, E (binary) is negative.

Filter Characteristics (Time Delay) of the Smoothing Filter

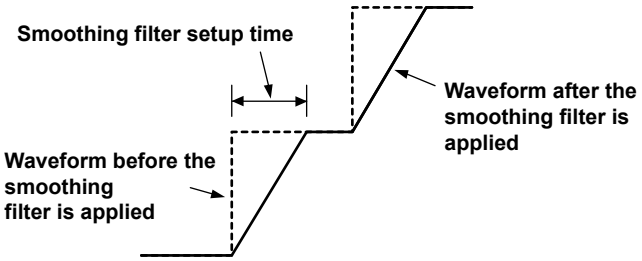
The smoothing filter is a moving average filter in which computation is performed in real time. The computation interval for moving averages is 40 µs (25 kHz). It is constant independent of the sampling rate of the DL850/DL850V.

The moving average order (the number of averaged points) is specified in terms of time. The maximum value is 25000 points (when the time is set to 1000 ms).

The characteristics of the smoothing filter are as follows:

- The filter is a low-pass filter.
- The pass band is flat.
- The filter has linear phase characteristics. The group delay is constant for a given filter order.
  The group delay can be derived through the following equation.
  Group delay = (the number of averaged points − 1) × 40 µs/2
- The filter has comb-shaped bandwidth characteristics.

The figure below shows the result of applying the smoothing filter to a waveform that changes in steps. The smoothing filter setup time follows the step change.


Smoothing filter setup time
Waveform after the smoothing filter is applied
Waveform before the smoothing filter is applied

Appendix 6 List of Preset Settings of the Frequency Module

Logic 5V

Setup Item	Setting
V Range	±10 V
Coupling	DC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	2.5 V
Hys	Yes[3]
Slope	Yes[4]
Chattering Suppression	Yes[5]
Pull Up	No

Logic 3V

Setup Item	Setting
V Range	±5 V (Probe = 1:1) ±10 V (Probe = 10:1)
Coupling	DC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	1.5 V
Hys	Yes[3]
Slope	Yes[4]
Chattering Suppression	Yes[5]
Pull Up	No

Logic 12V

Setup Item	Setting
V Range	±20 V
Coupling	DC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	6 V
Hys	Yes[3]
Slope	Yes[4]
Chattering Suppression	Yes[5]
Pull Up	No

Logic 24V

Setup Item	Setting
V Range	±50 V
Coupling	DC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	12 V
Hys	Yes[3]
Slope	Yes[4]
Chattering Suppression	Yes[5]
Pull Up	No

Pull-up 5V

Setup Item	Setting
V Range	±10 V
Coupling	DC
Probe	1:1
Bandwidth	Yes[2]
Threshold	2.5 V
Hys	Yes[3]
Slope	Yes[4]
Chattering Suppression	Yes[5]
Pull Up	Yes[6]

ZeroCross

Setup Item	Setting
V Range	Yes[7]
Coupling	AC
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	0 V
Hys	Yes[3]
Slope	Rising
Chattering Suppression	Yes[5]
Pull Up	No

AC100V

Setup Item	Setting
V Range	±200 V
Coupling	AC
Probe	10:1
Bandwidth	Yes[2] (Full cannot be selected)
Threshold	0 V
Hys	Yes[3]
Slope	Rising
Chattering Suppression	Yes[5]
Pull Up	No

AC200V

Setup Item	Setting
V Range	±500 V
Coupling	AC
Probe	10:1
Bandwidth	Yes[2] (Full cannot be selected)
Threshold	0 V
Hys	Yes[3]
Slope	Rising
Chattering Suppression	Yes[5]
Pull Up	No

EM Pickup

Setup Item	Setting
V Range	±1 V
Coupling	DC
Probe	1:1
Bandwidth	Yes[2]
Threshold	0 V
Hys	Yes[3]
Slope	Rising
Chattering Suppression	Yes[5]
Pull Up	No

User

Setup Item	Setting
V Range	Yes[7]
Coupling	Yes[8]
Probe	Yes[1]
Bandwidth	Yes[2]
Threshold	Yes[9]
Hys	Yes[3]
Slope	Yes[4]
Chattering Suppression	Yes[5]
Pull Up	No

When you select a preset, the setup items are automatically set to the values in the table. The meaning of Yes and No in the table is as follows:
Yes: The setting can be configured.
No: The setting cannot be configured (it does not appear on the menu).

1 Set the probe type to 1:1 or 10:1.
2 Set the bandwidth limit to 100 Hz, 1 kHz, 10 kHz, 100 kHz, or Full. You cannot select full for AC100V or AC200V.
3 Set the hysteresis to ±1%, ±2.5%, or ±5%.
4 Set the slope to rising or falling.
5 Set the chattering elimination value to a value from 0 ms to 1000 ms.
6 Enable or disable the pull-up. This setting is only available for Pull-up 5V.
7 Voltage ranges:
When probe = 1:1, select ±1 V, ±2 V, ±5 V, ±10 V, ±20 V, or ±50 V.
When probe = 10:1, select ±10 V, ±20 V, ±50 V, ±100 V, ±200 V, or ±500 V.
8 Set the coupling to DC or AC.
9 Set the threshold level to a value within the specified voltage range.

Appendix 7 TCP and UDP Port Numbers

The TCP and UDP port numbers that are used on the Ethernet interface of the DL850/DL850V are listed below.

TCP Port Numbers

Port Number	Description	Used For
20	File Transfer [Default Data]	FTP server, FTP client,* and a portion of the Web server
21	File Transfer [Control]	FTP server, FTP client, and a portion of the Web server
25	Simple Mail Transfer Protocol	SMTP client
80	World Wide Web HTT	Web server and WebDAV server
515	–	LPR client
1001	_	Instrument control through the Ethernet interface

UDP Port Numbers

Port Number	Description	Used For
67	Bootstrap Protocol Server	DHCP client
68	Bootstrap Protocol Client	(listen port)
123	Network Time Protocol	SNTP client

* The port number when FTP passive mode is disabled. When FTP passive mode is enabled, you can set any port number. When FTP passive mode is disabled, connections are established from the server. If you are connecting the DL850/DL850V from behind a firewall, enable FTP passive mode.

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